JUL 14 1924

VOL. VI. No. 3 JULY, 1924 Old Series Vol. XXII. No. 3

The Journal of Bone & Joint Surgery

The Official Publication of the
American Orthopedic Association
and of the
British Orthopædic Association

ISSUED QUARTERLY

372 MARLBOROUGH STREET
BOSTON, MASS., U. S. A.

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CONTENTS

PRESIDENTIAL ADDRESS. By W. S. Baer, M.D., Baltimore, Md.
OBSERVATIONS ON ARTHRITIS. By Loring T. Swaim, M.D., Boston.
THE MODERN TREATMENT OF TUBERCULOSIS OF THE BONES AND JOINTS. By G. R. Girdlestone, F.R.C.S., Oxford.
A SURVEY OF THE OCCURRENCE OF COMPRESSION PARAPLEGIA AND POTT'S DISEASE, WITH COMMENTS ON THE TREATMENT OF THE PARALYSIS. By Charlton Wallace, M.D., New York, N.Y.
A CASE OF MULTIPLE BONE LESIONS OF ATYPICAL ROENTGENOGRAPHIC APPEARANCE WITH THE PATHOLOGIC FINDINGS. By Charles L. Brown, M.D., and Daniel M. Stiefel, M.D., Boston.
PERIRENAL ABSCESS IN CHILDREN. By Walter G. Elmer, M.D., Philadelphia, Pa.
RADIUS CURVUS (MADELUNG'S WRIST). By B. H. Moore, M.D., Chicago, Ill.
HABITUAL DISLOCATION OF THE PATELLA. By W. E. Gallie, M.D., and A. B. Le Mesurier, M.D., Toronto, Canada.
REPORT OF A CASE OF CONGENITAL DEFECT OF PECTORAL MUSCLES. By C. B. Bennett, M.D., Berkeley, Cal.
THE IMPORTANCE OF THE AFTER-CARE IN THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP. By Z. B. Adams, M.D., Boston.
CONGENITAL ABSENCE OF THE RADIUS. By Katsuji Kato, Ph.D., M.D., Los Angeles, Cal.
A COMPARATIVE STUDY OF THE RELATIVE VALUE OF VARIOUS SURGICAL PROCEDURES IN THE TREATMENT OF INFANTILE PARALYSIS OF THE LOWER EXTREMITY. By James E. M. Thomson, A.B., M.D., Lincoln, Neb.
AN OPERATION FOR THE CORRECTION OF PLANTAR AND ADDUCTION CONTRACTION OF THE FOOT ARCH. By J. T. Rugh, M.D., Philadelphia, Pa.
PERIARTERIAL SYMPATHECTOMY. By Arthur Krida, M.D., New York, N.Y.
UNUSUAL CASE OF FRACTURE OF THE FEMUR. By James C. Wilson, M.D., Hartford, Conn.
CORRECTION OF BURN SCAR DEFORMITY BY THE Z-PLASTIC METHOD. By Stewart L. McCurdy, M.D., F.A.C.S., Pittsburgh, Pa.
A METHOD FOR THE CORRECTION OF PARALYTIC GENU RECURVATUM. By Clarence H. Heyman, M.D., Cleveland.
TRACTION FRACTURE OF THE LESSER TROCHANTER. By Irvin Balensweig, B.S., M.D.
A SIMPLE APPARATUS FOR PREVENTING TOE-DROP. By Berlin B. Nicholson, M.D., University, Va.
A WISHBONE CLASP FOR RETAINING EXTENSION STRAPS. By G. T. Tyler, Jr., Greenville, S.C.
OBITUARIES.
CLINICAL CONFERENCES.
NEWS NOTES.
BOOK REVIEWS.
CURRENT LITERATURE.

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VOL. VI, No. 3 JULY, 1924 Old Series: Vol. xxii, No. 3

The Journal of Bone & Joint Surgery

PRESIDENTIAL ADDRESS.

DELIVERED BEFORE THE AMERICAN ORTHOPEDIC ASSOCIATION, BALTIMORE, MAY 15, 1924.

BY W. S. BAER, M.D., BALTIMORE, MD.

Members of the American Orthopedic Association, Ladies, and Guests:—

Feelings and emotions of a contradictory nature fill my mind as I stand before you. I am, indeed, grateful for the honor you have done me in choosing me as your presiding officer for this year. When I recall the long list of honorable names which have been attached to this office, and remember not only the work of these men but also the distinguished services which they have rendered to our specialty, it is with a feeling of appreciation and gratefulness that I see my name added to that list.

On the other hand, there is a dash of sadness mixed with that pleasure. Your president is rarely chosen unless you feel that a certain sense of maturity has been reached—a maturity which, at times, borders on degeneration. It is not, therefore, without a certain degree of sadness that one realizes that in the minds of his fellows this process of degeneration is about to begin.

But, whether maturity has arrived, or degeneration begun, the election to the office indicates a past. As one grows older, one's mind becomes more analytic and retrospective. I have been thinking of the early days of this organization, seeking out the causes which have led up to the position of this Society in the surgical world of today; noting the

dangers with which, it seems to me, we are beset; and trying to peer into the future to see what paths we should follow in order that our ideals may be approached.

Our specialty was built on solid ground—broad and inclusive. It is not based, as are some specialties, on a more intensive study of a small portion of the human anatomy, but deals with the body as a whole. It was felt that to overcome deformities, whether congenital or acquired, and to restore the function of a disabled part, one must not only be trained in the practice and principles of surgery but must add to these the basic principles of physics and mechanics. This also demanded qualities of mind of a different type than those usually present in a general surgeon. It demanded patience—patience often continued over long periods of time. It demanded pertinacity of endeavor, constant watchfulness, and a spirit that was not to be disheartened by slow progress. It also demanded an optimism that would finally obtain its ultimate goal, but which, in doing so, would have to carry the burden of extreme anxiety, not only of the patient but also of the family, often over many weary months.

As most deformities are either congenital, or acquired early in childhood, it was but natural that our early colleagues chose the name of orthopaedic surgery—ortho, to straighten; paidos, a child. In order to straighten children an intimate knowledge of both normal and pathological bone, as well as the pathology and physiology of joints and locomotor mechanics of the body, had to be studied. The same knowledge which was essential to straighten children was necessary in the restoration of function of adults, due to disease and industrial conditions. Thus, a specialty which in the beginning was practically confined to children, today has about eighty per cent. of its work among adults. I am wondering whether, if the originators of the name which is derived from "ortho" and "paidos" were called upon today to designate a terminology for our specialty, they would consider the caption "orthopaedics" to be sufficiently inclusive. Perhaps we have outgrown our swaddling clothes. A little girl of three years may well bear the name of "Kitty," but "Kitty" at sixty scarcely carries the dignity which she deserves. It occurs to me that our specialty may be somewhat handicapped by its name. A few bright minds in bone surgery do not belong to our Association. Perhaps the "paidos" is the cause. You, yourselves, question yourselves, as seen in the name which you have given your official organ: namely, the Journal of Bone and Joint Surgery. Our Italian colleagues have named their official organ, Surgery of the Organs of Movement. Perhaps another name, other than orthopaedics, could be found, which would

more fittingly and more adequately stamp the character of work that we are all endeavoring to do.

Anatomy, physiology, pathology, physics, chemistry, and biology are the fundamental ingredients which, when properly mixed, form the science of medicine. Medicine may be divided into two parts: medicine and surgery. We should always remember that orthopaedic surgery is an integral part, but only a part, of general surgery. Just as a part can never be greater than the whole, so we must never allow our child to be greater than its parent. It is a fallacious mode of reasoning which permits one to generalize from the particular. This method will have baneful consequences if practised by us. On the contrary, to be true and accurate, we particularize from the general. In other words, to be a well equipped exponent of orthopaedic surgery, one must be, first and foremost, a general surgeon. He must know the history of general surgery and keep abreast of its literature. He must be cognizant of its development year by year. He must not only be skilled in operative technique, but his judgment on surgical problems must be sound and must appeal to the general surgeon, on account of that very soundness.

Fortunately for our specialty, its founders were men of mature mind and sound judgment, which comes only with long clinical experience. They had been brought up as general surgeons. They were surgeons. They felt, however, the need of other studies, as physics and mechanics, in order to carry out better that portion of surgery which particularly appealed to them. Hence, the birth of our specialty.

Today, there seems to me that there is a possibility of weakening our specialty by other and shorter avenues of approach. No longer is general surgery the only door which will open to our knocking. It is but human to try to reach one's goal by the shortest route. Is there not danger to the specialty in allowing men to take up the study of orthopaedic surgery immediately after their graduation? Do we all not need the breadth and poise and diagnostic instinct, which comes only after a thorough clinical training in medicine and surgery? May I ask how many of you would be willing to allow your associate or your assistant to wander through your own abdomen? The closest possible fellowship should be instituted between the general surgeon and the orthopaedic surgeon. There should be a reciprocal exchange of operations. There should be a reciprocal exchange of ward rounds. I believe that this would establish a bond of sympathy and mutual understanding which would be of incalculable good. The Membership Committee of this Association has it within its power to raise or lower our standard in the surgical

world. If they would convince themselves that every candidate is a surgeon in reality as well as in name, before he is admitted to membership in the American Orthopedic Association, they would thereby establish more firmly our position and increase enormously our prestige.

One would scarcely attempt to contradict the statement that orthopaedic surgery is the broadest of all surgical specialties. Unlike rhinology, urology, and opthalmology, which deal with small but important portions of the human body, orthopaedic surgery has to deal with the entire human organism. While the aforesaid specialties have for their object the removal of pathological conditions in their respective fields, orthopaedic surgery has to deal with pathological conditions of bones, muscles, and nerves throughout the entire body. But, after having removed the pathological process, it must use its knowledge in the restoration of function.

The points of contact with other branches of medicine must, therefore, be numerous. In no other branch of surgery is so broad an outlook demanded. Anatomy, physiology, pathology, physics and mechanics are absolutely essential. The clinical branches of medicine—neurology, pediatrics, psychiatry, urology, and larnygology, must be thoroughly mastered. The laboratory studies of chemistry, physiology, bio-chemistry, bio-physics, and serum therapy, are daily growing of more importance to us. Thermotherapy, hydrotherapy, muscle training, massage, and physical culture must be our handmaidens.

So it may be seen that while orthopaedic surgery is a part of general surgery, it is almost as much a part of general medicine. Unbiblical as it may seem, the orthopaedist must serve two masters—medicine and surgery. Just as he must be conversant with surgical problems and surgical technique, so must he acquire a deep knowledge of pathological changes and physiological and chemical reactions. He must have a keen diagnostic sense, which comes only after a long practice in physical diagnosis. He must have an unerring judgment as to when his surgical or medical methods should be called into action. He must have the ability to use his surgical technique on the one hand, or his medical therapeutics and serum therapy on the other. This nicety of decision demands the broadest medical training. What a field for the analytical mind!

As teachers of orthopaedics, we assume a definite responsibility to the students who are entrusted to us. We must be assured that the fundamental subjects on which medicine is based are interpreted to them, as they may bear on orthopaedic surgery. Take for instance,

anatomy. One must bring his clinical experience to bear in bringing these dry bones to life. Too often, it seems to me, the teacher of anatomy, if he has been brought up entirely in a laboratory, loses the fundamental point of view of a medical school. To my mind, the primary function of a medical school is to instruct its students to so use its teachings, and to apply them that they may either prevent disease or restore the sick to health.

Anatomy, as usually taught to the average student, is as a dead language. You learn its vocabulary in the terms of muscles and nerves and bones, and often, you soon forget. Not only should the student be taught the topography of the various structures in the body, but he should also be taught the intended use of those structures in the "movies" of life. He should be made to realize the function which they are to perform. A physiological anatomy—a living anatomy—the anatomy of the body in action. Orthopaedic surgery, as no other branch of medicine, is based on anatomy. The man who teaches our specialty must have had a large experience in clinical observation, in order to bring home to the student, not only the pathology which has produced the deformity and loss of function, but the living physiological anatomy on which all rehabilitation and restoration of function must be based.

There is a tendency in some medical schools, it seems to me, to under-value the ability to teach. Preference is apparently given appointees for their supposed ability in laboratory research work rather than for their ability to instruct the student. No one, more than I, appreciates the value of original investigation. It is the principle which leavens the mass. It formulates general principles. It stirs the imagination But you cannot raise babies on ice cream. They must be fed on a carefully prepared diet, ever increasing in nutritional value, according to their ability to digest it. Men who are to teach others how to practice medicine and surgery, must be men who have used the world as their laboratory. They must be men of large clinical experience. They must be men who have the power to impart that which they have learned, that which experience has taught them. Would that we had more Oslers at the present day! The reputation of a medical school depends on the attainments of its graduates: attainments as practitioners of medicine and surgery; attainments as teachers of authority and distinction; attainments as research scholars after truth. The reputation of the graduates will depend on the broad clinical experience of its professorial body and on its ability to impart that knowledge, and its power

to stimulate the spirit of investigation. This is the *sine qua non* of a good teacher.

Orthopaedic surgery, particularly that part pertaining to the crippled child, appeals temendously to the sympathy of the public. We have gotten away from the brutal doctrine of the survival of the fittest and from the horrors of the Ganges. Today a more Christian spirit prevails, and we are salvaging and restoring a large part of the crippled population.

Hospitals for the restoration of the crippled child are being lavishly constructed in this and other countries. All praise to our benevolent citizens, to the Shriners, to the Rotarians, to the Kiwanians, and other organizations. The work they can accomplish, and the restoration they can make possible will be of incalculable value.

Allow me just one word of warning in our children's hospital work. That is, beware of isolation, the loss of contact. Real growth depends on the number and character of our contacts. Isolation leads to false standards and an ever narrowing point of view. We are a part of general surgery; a part of general medicine. It behooves us to keep in contact with these subjects. I, personally, believe that all our children's hospitals should be an integral part of some medical school, and whenever possible, a part of a medical school affiliated with a college or university.

We need the university spirit—the spirit of truth for truth's sake, the spirit of research. We need to touch shoulders constantly with fellows in other fields of medical endeavor. We need their criticisms. We need their approval. We need the stimulation which comes with scientific battle. We need to be subjected to the merciless criticism of the undergraduate students. We need their pertinent, and at times, impertinent suggestions. Beware of isolation.

Many of you before me, indeed most of you, have your own hospitals, or control a service in a hospital in which cases of an orthopaedic nature are treated. You are aided in your work by an enthusiastic group of associates. The first consideration of your hospital is, and should be, to restore the health and usefulness of those patients who are committed to your care. As far as possible, you are to relieve them of their disability, and in rehabilitating them to restore them whenever possible to their previous occupation.

But besides this there is another function which should always be kept in mind, a duty one owes to his specialty and to the advancement of science. Research work of a high order should be diligently pursued, thereby helping not only the patient entrusted to you but also generations yet unborn. It is by careful, thoughtful research work, either in clinical

branches or in the laboratory, that we are most liable to find the divine spark which leads to light and life and the advancement of our science.

Whatever may be our views on immortality after death, surely there is an immortality in this world for all of us. No one lives unto himself. We are affecting, perhaps unconsciously, every individual with whom we come in contact. From a professional point of view, you are made immortal by the impression you can deliver to your students. A teacher lives in the character of men he produces. Your immortality is made also by the research work you do, and on the character of that work. Every true piece of scientific research affects the scientific world as much as our personal contact affects our friends. John Hunter has become immortal to all medical men. One should arrange his own time, and in organizing his staff provide sufficient time for them, that all may in some measure seek the Goddess of Truth by individual research. This is not always easy of accomplishment, particularly in this country. Our commercial world is so filled with the spirit of bustle and rush and short-cuts that it has infected the realm of medicine. It is difficult to so abstract oneself from the professional duties of the day as to obtain a proper time for contemplation and research. Means, however, should be taken to bring it about. Besides providing one's assistants with the time and materials with which to produce, fellowship for research in all orthopaedic hospitals should be established. This, I am sure, could be done with a little effort. It already had been done in many places. The general public and civic organizations are more than sympathetic to such an appeal. Ask and ye shall receive.

In closing, I am reminded of a delightful little essay by Edward Bok entitled, "What did Father do?" Some day, posterity will ask concerning each and every one of us—what did he do? Not, how much money did he make, but what did he do for humanity? What did he do to enhance the reputation of his profession? What did he accomplish?

The works and the accomplishments of the American Orthopedic Association have been numerous and important. A new specialty has been brought into being within the life time of the Association, a specialty which is firmly fixed in the hearts and minds of men. The future lies before us. I believe the answer to Mr. Bok's question, "What did Father do?" in so far as this Association is concerned, will be one of which every one of her sons will be very proud.

OBSERVATIONS ON ARTHRITIS*

BY LORING T. SWAIM, M.D., BOSTON.

Most of us have had arthritis at some time in our lives. Some members of our families have had joint pains. Most persons get well without aid from the physician, but a large number do not recover and are crippled because of the joint changes which take place.

It has seemed that the balance between active and non-active disease in many cases was a very delicate one. In the study of the cases, part bed, part ambulant, this has seemed true. The recovery or the reverse often apparently depended on slight changes in various factors, in focal infections, in intestinal function, in foods, in disturbed physiology, and in functional disturbances due to poor body mechanics.

The types studied have been varied,—from the infectious, atrophic, and hypertrophic variety to the Still's disease of childhood and the Strümpell-Marie "poker-back" type.

The symptoms have been from the very mild, transiently painful joints to the completely ankylosed patient. Some have responded promptly to treatment; others have been slow drawn-out problems; others have gone too far for human power to restore to usefulness.

In the light of this study, which has extended over the last ten years, I have drawn up a series of observations. My first point is in regard to foci of infection.

Foci of infection undoubtedly play their part in the production of arthritis in general. Everyone has had patients who apparently were cured by the removal of infections, and again we have seen patients go from bad to worse even after a septic focus has been removed. The worst infectious cases, of course, are the gonorrheal. Most of our patients have had all demonstrable foci painstakingly removed several years before we saw them, and they still had active disease in the joints. The question naturally arises: was the disease due to the infection or was it due to the general condition or lack of resistance of the patient? By this I mean: was not the arthritis due to physiological and chemical con-

* Read at the Annual Meeting of the American Orthopedic Association, Rochester, New York, May, 1923.

ditions present, in which the infection was only an added factor, the removal of which was not enough to sufficiently tip the scales in favor of the patient?

Our observations have led us to believe that arthritis is a problem of physiology and biologic chemistry in which infection may or may not be a disturbing factor. Infections in mild cases may upset the physiologic chemical balance enough to cause symptoms, and removal gives relief, but this does not seem to be true in some cases. There must be other factors present. There are innumerable theories to explain this on a bacteriologic basis. I cannot discuss these because of the time allotted to this paper.

Many of our cases and those of other observers demonstrate the fact that arthritics get well in spite of known septic tonsils and teeth, through improvement in the general health and correction of physiology and chemistry.[1]

The judicious removal of demonstrated foci is legitimate, but no arthritic should be subjected to the strain of tonsillectomy or wholesale tooth pulling or other operations without very clear evidence that the operation is necessary beyond a doubt. The operation and sudden lowering of resistance may be the "last straw" for the patient. Many times it is better to build up the general health first and so avoid the danger of doing real damage. This has proved true in several of our cases.

Much harm to healthy joints can be done by lowering the vitality through untimely and ill-advised removal of a focus of infection. It is just enough to tip the scale against them.

The second point is that recognition of the types of arthritis is of great importance from a treatment standpoint. There are at least two types, the atrophic and hypertrophic. There is much dispute as to whether the atrophic includes the infectious type (that without bony change other than general bone atrophy). Personally I class them separately. So far there has been no proof either way. I believe the true atrophic case is more unstable than the infectious type and shows more atrophy of muscles and bones. There is more disturbance of physiology and chemistry than there ever is in the infectious group.

These two main types are opposed to each other in several ways. The atrophic arthritics are atrophic all over: skin, nails, hair, muscles, and bone. They have acid saliva, sweat, urine, and stools. They have subnormal temperature and blood pressure. The hypertrophic arthritics are not as a rule subnormal. They are not run down. They are not

acid in their secretions. Their disability comes from the mechanical irritation of the bony spurs, not from inflammatory processes.

The atrophic arthritic is very unstable under strain, fatigue, and changes of any kind, as compared to the hypertrophic.

Atrophic arthritis occurs chiefly in the light-boned, slender type of person; hypertrophic, in the heavy-boned, "broad back" type.

Because of these differences in the atrophic and hypertrophic cases they should be treated differently. The atrophic patient who is suffering from bone atrophy and general disturbance of the bone chemistry needs building up and correction of the faulty physiologic chemistry so that bone elements are laid down. The hypertrophic patient primarily needs relief of strain for the joints, and secondly the correction of the physiology so that excessive bone depositions do not occur in the strained areas.

The former requires diminution of the acidity through food, alkalis, and elimination, and an abundant supply of the bone building materials. The physiologic functions of the body should be increased by foods properly chosen and by the correction of faulty body mechanics to make assimilation of those easier, greater, and more complete.

It, therefore, has seemed of importance to carefully differentiate the particular type of bone changes in each case.

The third point is the recognition of the intestinal factor in arthritis. Whether we believe in bacterial toxins or food toxins is of great interest, but does not help us much toward relief of the patient. The point is: what are the intestines, and especially the large intestine and ileocecal valve, doing? There are two broad types of constipation—flaccid and spastic. There are two types of cecum—the normal type and dilated pendulous type. There are two fundamental types of valve—the competent and the incompetent.

Observations lead to the conviction that the hypertrophic arthritic with the heavy type of anatomy has the big large intestine. He tends to have flaccid constipation with big cecum and sometimes an incompetent ileocecal valve. The large bowel is often sluggish and the peristalsis continually leaves behind some of the old material. This is extremely foul when cleared out. It is surprising to see how much can be washed away and how many days of irrigations and castor oil are necessary to clear the bowel in some of these cases.

These intestines are very frequently distended, atonic, and sagged. The heavy, pendulous abdomen causes serious postural strain to the

back, knees, hips, and shoulders, where most of the hypertrophic changes are found. Correction of the postural fault not only relieves the sagging viscera but is essential for the relief of the progressive process in the strained joints. The atony and functional failure of the bowels is frequently overcome by support and exercise.

The atrophic patient being usually of the slender anatomic type has the shorter intestines and tends toward spasticity. The difficulty in these cases is largely due to the loose, floppy cecum, which is low (at the pelvic brim) and is very frequently dilated, causing an incompetent valve. In such cases there is a persistent puddle in the cecum. This is tender and chronically irritated even to the point of a mucous colitis. Absorption results. These are most difficult cases to correct because of the chronic colitis present. The threshold between the symptoms of toxanemia and well being is very slight. Often one day of constipation will produce joint pain. Constant clearing out with enemas, periodic doses of castor oil, and daily cecal massage are necessary to prevent absorption and to raise the threshold of susceptibility to a point where a temporary constipation and absorption will not cause an acute exacerbation of joint symptoms.

The points to be remembered in these cases are: the congenital type of loose organs, the loose cecum, and the colitis. Remembering these, they can be helped by support, non-irritating foods, massage of the colon, mild catharsis, and correction of position, resulting in better functional capacity through correction of body mechanics.

These dilated, ill-functioning, inflamed cecums will get well. They are one of the mechanical factors in the poor physiology in the atrophic and infectious cases beyond question, because they are so frequently found and because of the prompt relief of the joint symptoms following the evacuation of these dilated cecums.

So far no satisfactory chemical test for intestinal absorption has been found. Possibly the acidity of the saliva and sweat may be found to be a guide.

The mechanics of intestinal function should never be overlooked in either type of arthritis.

The fourth point to bring to your attention is the acidity present in the atrophic cases.

For the last five years it has been noted that the saliva of the atrophic arthritic (sometimes in the infectious) and very rarely in the hypertrophic was acid to litmus paper. No explanation of this has been found

except the theory that it was a manifestation of some general acidosis. In the neutralization of this acid condition we have tried excess of alkalis of one kind and another with varying success. Often the alkalis would give as much relief for pain as aspirin and in some mild cases apparently were beneficial. The results have increased our belief in a general acid condition. Recently Dr. Percy Wilde[2] of England has claimed that the sweat is always acid in rheumatic and rheumatoid arthritis. He claims the acid is lactic acid and that elimination of this by daily thermal baths will ultimately remove this acid. For thirty years he has been perfecting his theory. He says that the arthritis is due to the failure of the sweat glands to eliminate acids. These accumulate in the tissues by uniting with phosphate of lime. When set free by a sudden rise in temperature without elimination this acid produces irritation of the tissues bathed in lymph and sets up an inflammation. His object is to raise the temperature and at the same time cause elimination by sweating. He does this by raising the body temperature one or two degrees in a moist atmosphere causing sweating at a temperature of 102-105. This he claims has relieved many cases of the infectious and atrophic groups, but is not applicable to hypertrophic arthritics who are not acid. So convincingly did he demonstrate this last summer that since January we have been trying his methods on some thirty cases.

All the arthritics, except the hypertrophics, so far treated, and some extremely nervous cases have shown acid sweat; none sweat normally and freely. Most have dry skins and most have continued to have acid sweat for sixty to one hundred days of sweat baths. The sweat does become neutral finally and three cases which have returned for a sweat test after six weeks' rest had remained neutral. Dr. Wilde claims this is permanent if the physiology of the skin is not again checked by chill or exposure. It is true that the skin over the inflamed joints is more acid to litmus paper than in other parts of the body. The hands and feet are always acid in all patients tested. The normal person when sweated at 105 degrees has acid sweat at first which becomes neutral in 25 to 30 minutes.

These few patients treated by the thermal bath have certainly improved as far as pain, swelling, and stiffness are concerned. Several were old patients where all other means had been tried without success. The thermal bath when added to their regime seemed to help.

It is, of course, too soon to make a detailed report of this new work. It, however, can be stated that this form of sweating causes decided

changes in the venous blood, and through the fever produced must increase the metabolism of every cell in the body.[3]

Much chemical study is needed to find out what actually does take place. This is being done.

This is what we observe in the patient: better color, more normal skin, less pain, less tenderness, less congestion. There is less nervous tension, with better nights and eventually less swelling. Those with chronic temperatures have come to normal. Most have eaten better and gained weight. Whether, after a neutral sweat is secured and the acid eliminated, they will continue to improve, cannot be stated as yet. Five have continued to improve when seen three months after treatment was stopped. Undoubtedly this method of elimination will be of value in certain cases of arthritis, but it has its dangers. In heart cases and those with extremely low blood pressure and low hemoglobin, it should be used cautiously. In one case an acute condition much resembling rheumatic fever was produced. The thermal bath is not applicable for the hypertrophics because their sweat is not acid. That raising the temperature and sweating has a definite effect on the body physiology, chemical study has already shown, the results of which have not progressed far enough as yet for publication. It has opened a new field for physiologic study.

The fifth point in the study of arthritics is in regard to foods. Dr. Pemberton[4] has given us the knowledge that excessive diets especially rich in carbohydrates are detrimental to arthritics in general.

Attention should be drawn to our demoralized foods and their probable effects on all forms of acidosis. They are known to produce conditions such as scurvy and beriberi. The lack of lime and phosphates is important for bone health. For building and replacement of our bone salts, food rich in minerals is essential. The recent work on rickets has been enlightening in this aspect of bone diseases. Dr. Percy Howe[5] of Boston has produced joint disease in guinea pigs by a scurvy diet. They resemble atrophic arthritis. The lack of mineral salts and the inseparable vitamins in our diet has steadily increased as our food has been refined until we are living on a highly acid forming diet. This includes meat, white flour, potato, white sugar, and candy. We do not eat enough alkaline carbonate forming fruits, green vegetables, and whole grains, so that we are deficient in mineral salts. Whether this food deficiency is responsible for some of our increasing atrophic cases cannot be stated. Because orange juice has helped the animals with scurvy joints

which resemble our atrophic cases, it was given in excess to a series of cases with apparent benefit; several had less pain. Fruits, green, fresh vegetables, lime water, vegetable soups, whole grain—all of which contain the acids necessary to the formation of alkaline carbonates in the body—have been given. Apparently this has helped, although this alone has not changed the acid reactions of the saliva, sweat, or urine. There has been a noticeable change in the joint pain, with better circulation and muscle tone following long periods of use of such diets.

Temporary improvement has been produced from a concentrated mineral diet, such as bran water, spinach water, vegetable soups, fruit juice, egg yolk, lemon juice, all alkaline base forming material. Our experience is that arthritics do not habitually eat this kind of food and dislike vegetables, especially greens. It is interesting, but is no reason for cause and effect.

The last and most important point is that no matter what food we give, no matter how much we eliminate by the skin and intestines, no matter how many foci of infection we remove, we must make the patient's machine capable of assimilating the food, of normally eliminating the waste, and of developing normal resistance.

The diabetic has been treated by fitting the diet to his sugar tolerance. By supplying him with insulin we now can increase his tolerance and make him use sugar for his body building. Pemberton has shown that by dieting we can cater to a weakened function in the arthritic.

Attacking the problem from another angle, cannot the body be made to handle food correctly, to eliminate normally and thus restore the normal functions—not cater to them indefinitely? This can be done by correction of defects in physiology resulting from bad body mechanics. Just as bad mechanics affects a joint in weight-bearing, it also affects the functional capacity and inter-relation of the organs of digestion, assimilation, circulation and elimination.

It has been demonstrated again and again that improvement takes place in many cases when all the organs of the body are given a chance to work harmoniously together.

In the stoop-shouldered, flat-chested, relaxed abdomened people, the diaphragm is invariably low, carrying with it the heart and all the organs below it, stretching some, compressing others. *The importance of a low diaphragm cannot be over-estimated in these cases since its normal action controls much of the circulation.* The poor physiology resulting from this condition so constantly present in arthritics can well explain their failure to respond to treatment unless this lack of bodily harmony

can be restored. Bad body mechanics can be corrected and it is often surprising to see the rapid change which takes place in the circulation, assimilation, and the increase in physiologic functions of the abdominal organs, and with these in the arthritis. Some of our out-patient cases have improved remarkably with nothing but corrective exercises and rest periods.

We have found that correction of body mechanics through carefully graded exercises, supports, rest positions which promote better functioning of the heart, lungs, and abdominal viscera when carried on systematically, have resulted in arrest of active joint symptoms and the return of joints to use which would hardly have seemed possible.

From these observations we feel that continued permanent improvement in many cases of arthritis is dependent on normal physiology and chemistry of the body as a whole. This in turn, is dependent on the normal physiologic use of the body. The difference between health and functional disturbance may depend on very slight mechanical defects.

The patient has not received full treatment until his body has been prepared to utilize our diets and to continue our attempts at elimination of waste products.

CONCLUSIONS

1. Arthritis is more than an infection, it is a problem of physiology and chemistry.
2. It is a problem of foods, assimilation, and excretion.
3. The skin secretions are found to be abnormally acid in atrophic arthritis, including the infectious group.
4. Recovery from arthritis is dependent on several factors: the removal of infection where possible, the type of food, assimilation and excretion, the general resistance secured by normal physiology and chemistry. This is aided by the normal physiologic use of the body through corrective exercise and better body mechanics.

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DISCUSSION ON PAPER OF DR. SWAIM

DR. MARK H. ROGERS, Boston, Mass.: The opportunity that this group of men has for studying arthritis in the clinic of the Massachusetts General Hospital, and Dr. Swaim represents a certain group in this clinic, and at the Robert Bent Brigham Hospital, is so great that I am willing to place a good deal of confidence in their opinions as to the treatment of arthritis.

I would like to discuss the question of what he calls the atrophic arthritis, which we all know means the common type, and its relation to intestinal toxemia as he expressed it. What I have to say is rather critical. It seems to me that my scientific internal medical friends are very apt to criticize a lot of the statements we are making in regard to chronic arthritis, statements as to the type of the intestinal tract, the effect of a loose iliocecal valve, etc. The effect of that condition on arthritis may be true but from that standpoint and from a physiologic standpoint, I am not at all sure that it has been proven whether there is an effect. Personally I feel that intestinal toxemia probably has a good deal to do with the so-called atrophic arthritis, but when it comes to putting it on paper and presenting it to this Society, that certain things are true and certain things are so, it seems to me, with this great study of cases, we ought to be able to put it on paper in a way to convince the medical man. I do not think that Pemberton's work has convinced the medical man that the food factor has special influence. My reason for criticising them is the desire for them to bring out a certain definite group of facts the same as they have in diabetes, and then you can get from these facts what is now needed and what ought to be discarded in the treatment of arthritis.

THE MODERN TREATMENT OF TUBERCULOSIS OF THE BONES AND JOINTS*

BY G. R. GIRDLESTONE, F.R.C.S., OXFORD.

DURING the first twenty-four years of the twentieth century, the improvement in the treatment of this condition has been so great that it has almost amounted to a revolution; it has indeed been revolutionary in that the change has been from one extreme to another, but it has differed radically from most revolutions in that the process has been almost bloodless and entirely beneficial. Even twenty years ago tuberculous disease attacking the spine or the hip dealt hardly with the bodies of its victims; only too commonly the story was one of persistent pain, increasing deformity, sinuses profusely discharging, the dragging out of months, then the beginning of lardaceous disease with its added miseries, and at the last end, death. It was about this time that Miss Hunt, at Baschurch, and Sir William Treloar, at Alton, were organising the hospitals which have done so much to change the picture. For though even now the story of a case here and there may be unaltered, each such tragedy is due to somebody's ignorance or neglect. There is nowadays little excuse for delay in diagnosis or the prompt admission to a special hospital which should follow; and if admitted in good time the patient quickly loses all his pain; ceases to go down hill; and starts the slow process of recovery. Although many papers have been published, for the most part they have concerned one or another aspect of the subject. A new splint has been described or an old one recommended, a new operation devised, or all operations condemned; at one time our attention has been focussed on the sun, a factor in general treatment; at another on specific treatment in the shape of a new form of tuberculin. As a result of all this it has been difficult to see the subject as a whole, clearly, and in true perspective.

I have long felt the need for a general review of the modern treatment of the disease in the light of the better understanding we now have of the relationship between the human host and his unwelcome but most persistent guest, the Tubercle Bacillus. Our present compara-

*A paper read at the Provincial meeting of the Tuberculosis Society at Cambridge, April 11, 1924.

tively happy state, no doubt much to be bettered, has been brought about by the clinical work and teaching of many leaders. In our own country, the names Hilton, H. O. Thomas, Howard Marsh, Robert Jones and Gauvain should always be remembered; also those of Miss Hunt, Miss Beavan, Sir William Treloar and Andrew Gibson (though not of our profession) for without their gifts of skill, labour and money the great hospitals in Shropshire, at Leasowe, Alton, and Heswall might never have been. But our position, though happy, is not quite plain, during a period of rapid progress this is natural and good, there is no uniformity of method, and even of aim not quite a unanimity, to be seen in the practice of the leading special hospitals. They are human institutions and rightly reflect the ardour, but with it the fanaticism, of their genius loci, whether he worship the sun or the Thomas tradition. Each has special virtues and perhaps a human touch of fallibility. But if you question their results visit them and see their patients; it will dissipate your doubts and cannot fail to be a pleasure. In this review, as in the practice of my own hospital, I have tried to learn from them all with appreciation yet critically. To get the most out of this one's judgment must be based on a thorough understanding of the disease, the method should then lead to the construction of an outline of treatment applicable to the great diversity of cases.

1. First then what is the character of this disease? and the relations between the host and his guest?

2. Secondly, how can we be most effective in helping the former to rid himself once and for all of the clinging attentions and the unwelcome advances of the Tubercle Bacillus? [My review must cover first the modern conception of the disease, then the general treatment of the patient and finally the local treatment of bone or joint focus.]

I.—THE CHARACTER OF THE DISEASE.

I think we are still too prone to think of spinal caries (or hip disease) as if it were just that, and nothing more. No mistake could be more grievous. Spinal caries—or any other bone or joint focus—is an obvious manifestation of a hidden deep-rooted disease. Spinal caries shouts for recognition, deep seated lymphatic tuberculosis takes no steps to call attention to itself. A grumbling focus in a mediastinal lymph gland

does not seek publicity, while hip disease advertises with limp and pain, night cries and muscular rigidity, and a tuberculous knee is painful, swollen, and hot to the hand.

Tuberculous disease of a joint or a bone is serious enough, but it is a weed with a very deep root; you may pluck the head, but the root will not come with it. A bone focus is a proof of established tuberculous infection of the body; but even this is not all, for the new focus is tangible evidence that the invasion of the body is advancing. For months or years trench warfare has been carried on in the deep-seated lymph glands; from time to time there have been attacks, bacilli have been distributed in showers by the blood stream, but the tissue cells have known how to deal with them. But now the enemy has had a great success and got a new hold. Things are going wrong.

The rival powers of Man and Tubercle Bacillus seem very delicately balanced. The virulence of the Tubercle Bacillus in bone and joint disease is almost invariably constant. This has been shown by Eastwood, A. S. and F. Griffith,[1] who have recorded a large number of animal and cultural tests of bacilli concerned in surgical tuberculosis.

Man then is the variable factor. In good circumstances he has the upper hand: under sufficiently bad conditions he becomes its prey. There appears to be a wide limbo in which the balance is almost equal and neither can finish off the other. In this long drawn combat time favours the bacillus until steps are taken to restore the vitality and renew the vigour of the patient. Fighting goes on wherever the bacilli establish themselves after penetrating the lining membranes of the body; to begin with as a rule only in the lymph glands, then also in any focus that is developed; from time to time, during and after bacillaemia, action and reaction become widespread. In the end one side or the other must win.

So fateful is this fight between man and his enemy. But it is a fight in which we can join, and treatment has now become so effective that we can ensure complete victory for our patient in almost every case. We can decide whether the patient will almost certainly recover or run very grave risk. I firmly believe that the responsibility of this decision rests jointly upon those on whom it falls to authorise the admission to hospital and pay the maintenance and upon those who carry out the treatment. Here is a large group of cases in which treatment can make a decisive difference. The main part of our treatment is one to which we should be well accustomed, the task of helping the patient to cure himself; but now we know how to help him successfully, and we also

know that without that help he often fails altogether or, at best, only partially succeeds.

But success costs time and money. At present these necessaries are often dealt out to us so grudgingly that we are driven to make a fine art of spending the smallest possible sum on the treatment of each patient so that the work is neither extravagantly finished nor spoilt for lack of the last essential halfpenny. This makes our task not only very difficult, but often very unsatisfactory if we have to let children go out of hospital before it is safe; for while it is comparatively easy to restore health in an open air hospital it is difficult to maintain that health after the patient goes home and often impossible if he goes too soon. Similar causes produce similar results: a deep-seated tuberculous infection, and his home conditions, produced the focus for which our patient came into hospital. If he goes back with the infection inconclusively checked, and his home conditions are unimproved, it is only reasonable that he should relapse, for his vitality and powers of resistance are likely to return to a low level and his tissues may again become susceptible. Further showers of bacilli may follow and lead to a new focus, or the old focus may be lit up again. This is no fantastic tale but, unfortunately, quite a common story. Relapsed cases in surgical tuberculosis are still frequently met with, and we have not yet fully realised that the responsibility is ours, that their relapse indicates our failure! We could have chosen success, we have chosen to risk failure. We can but try to set it right, and see to it that it does not occur again. Of course if money has been stinted the Tuberculosis Officer and his Health Committee have the burden of responsibility.

It is said that specialists see, not their own failures, but those of others. Not long ago, a surgeon, who came to spend two or three days with me to see the work of the Wingfield Hospital and its clinics told me that he had visited a great centre for surgical tuberculosis on the Continent, afterwards another some hundreds of miles away. At the second place he had been told that they spent a good deal of time operating on patients who had been previously treated at the first. He saw several such cases, took their names and went back to the first and found that they were down as cured in the records there. This is no reflection on the institution. These anomalies must commonly occur where a patient goes to a distant hospital, is apparently restored to health, then returns to his home where he cannot be supervised by those who have carried out his hospital treatment. A cure in one hospital's register may be a very sick patient in another hospital's bed. This is tragical for the

patients; misleads the surgeons; and falsifies statistics. But it is an experience that is disappearing where the hospital staff make certain of maintaining constant supervision of their cases after they go home. We do this in the district of three counties which the Wingfield Hospital serves, and in so doing we learn how great the need is, and how great the benefit. For we are thus able to readmit a case as a precaution where general or focal signs show that all is not yet quite well.

Continuous supervision is the first essential, the second is support of the local authorities, given through Tuberculosis Officers who have persuaded their Committees to allow them adequate funds, so that there need be no delay in admission, the original period in hospital need not be curtailed, and re-admission can be promptly authorised when necessary.

Of course, failure comes from time to time, sometimes from one's own fault, but at other times there has been no opportunity of ensuring success. A patient may only reach one after much time has been wasted and illness has so far increased that the bacillus has long had the upper hand. Still more serious is it if septic infection has occurred and bacilli and cocci have joined forces against the patient.

There is, then, a balance between attack and defence; on the one side the bacillus with unvarying virulence, on the other the patient with powers which vary with his environment: he comes to hospital with the scales weighted against him; given time we can bring them down in his favour. Furthermore there is time, this is no rapid disease over in a few days or weeks. But time is a two-edged weapon for if we have time to set things going the right way, so it takes time to put things finally right. Further, if we have time on our side in which to help the patient we must treat time as a valuable ally, and not cast off the alliance before the victory is decisive, and final. I do not claim that there is anything new in the conception of the disease I have put forward. Rather is it, I think, generally accepted. If I have laboured the point it is because it is practical, and the effect on practice is vital, an effect which seems incompletely grasped, or if understood still often neglected.

II.—THE TREATMENT OF THE DISEASE.

The aims of treatment are general and local.

I.—First to raise the patient's general vitality as quickly and as fully as possible.

II.—Ultimately to restore the full health of the patient, who should be free from any sign of tuberculosis, focal or general, with his powers of resistance to the Tubercle Bacillus so raised as to enable him to repel any further attack.

III.—The prompt elimination of any factor, such as strain or movement, harmful to the diseased part, and the application, so far as possible, of rest, comfort, and stimulus to local circulation.

IV.—The avoidance of septic infection.

V.—The restoration of the strength and function of the affected part.

These points are usually best achieved by prompt admission of the patients to an open air Orthopædic Hospital. The development of perfect technical methods of treatment is the first duty of the hospital staff, the organisation of team work to bring the patient promptly to that treatment is another, and for this they must rely on the help of the doctors of the district as well as the Tuberculosis Officers. A little delay, then a little postponement, and we may find the disease has become, to quote the words of Perceval Pott, "Most melancholy to see, most miserable to endure." We can neither afford to delay nor remit any established principle of treatment. The virtues of sunlight and moving air should not induce us to relinquish the accuracy of our splintage. Operations may be helpful, or even essential to cure, but to consider them as short cuts is a sin which will be visited on our patients. Rest and time remain the essential ingredients of our prescription. We may know better how to supply true surgical rest to inflamed and damaged parts, we may spend the time to better purpose, but Howard Marsh might be speaking today when he said:—

'Now it is much more important to recognise the fact that these tuberculous affections are curable in their early stages than to dwell on the destructive changes to which they give rise at a later period. . . . As obstinate local inflammations, tending to relapse, they call for the application, at the earliest possible moment that they are detected, of two great principles of treatment: first, that of long-continued and perfect rest, which will secure them against the effects both of external injury and of reflex muscular spasm; and, second, the prevention of deformity by the aid of some adequate mechanical support. When

these two conditions are fulfilled, and when patients are placed in favourable circumstances as to open air and good food, recovery, with complete restoration of the function of the joint is, in a large proportion of instances, simply a matter of time.'[2]

MODERN METHODS OF TREATMENT

A.—*General Treatment.* We have as yet no certain means of developing an active immunity in our patients. This is the great hope of the future for which we look to our colleagues of the laboratory. Meanwhile all our skill and more is wanted.

General treatment comprises the skilled use of four great natural remedies. *Rest, good feeding, open air, and sufficient time.* Of the rest and the time, Hilton and Thomas have said all that is necessary and said it the one with charm, the other with emphasis! There is something to be said about food, and open air is the most modern and least understood of the four remedies.

Good Feeding. Food must be adequate but not excessive, simple but well-cooked and attractive, appropriate to the season and the weather. Our patients do not need fattening unless they are too thin, they need building up in the sense that their bodies should and can be brought to perfect physical fitness. Their diet should be simple, well-mixed and without too much meat. Our patients are very much exposed to the weather and when it is cold require more food and especially more fat. In very hot weather on the other hand, flesh and fat should be very largely replaced by fruit and vegetables. I found Dr. Rollier a firm believer in simplicity and in limiting meat and milk. In cases of septic infection, he cuts them down to a minimum. Plenty of water should be given, mostly between meals.

THE OPEN AIR.

THE ACTION OF THE SUN AND THE WIND IN TUBERCULOSIS.

I know that it is most unfair to both to consider them apart; let them act together and they perform great wonders, separate them and much of their magic power is lost. Yet it is right to examine separately the contributions each can bring toward the healing of our patients so that we may use them to the greatest benefit. For all is not plain sailing yet.

The Sun.—Direct Action. Ultra-violet rays are stopped in the outer layers of the skin: in large doses they destroy bacteria on the surface and epidermal cells; in smaller doses they stimulate the cells and tend to produce pigmentation. The sun's rays, as their wave length increases from violet towards red, gradually lose photochemical activity but gain in penetration and heating power. They penetrate beyond the skin but have little or no bactericidal action.

Indirect Action.—A. *Photochemical.* It is unknown whether epidermal pigmentation or some other (hypothetical) reaction is associated with an indirect anti-bacterial or antitoxic effect in tuberculosis. That there is some indirect photochemical effect is clear from the danger of rousing focal or general reaction in patients unprotected by pigment; but I know of no proof that the effect is antibacterial or antitoxic. We should also remember a possible indirect effect on our patients by the action of sunlight on the air they breathe.[3]

B. *Calorific.* The skin is heated throughout its depth, the arterioles in the corium dilate, and the circulation in the skin becomes very active. Turrell has taught us that our bodies are blood-cooled in the same way that the water circulation carries away the excessive heat generated in the cylinder of an internal combustion engine. The warmth and increased circulation in the skin intensify its metabolism.

But the strong rays of the summer sun, if unchecked by cool and moving air quickly overdo this heating, the skin and the whole body get too hot, general loss of tone results. Any further overheating leads to danger. Thus we learn that free use of the sun's light without protection, or of its heat without associated cooling, is wholly bad.

Thus catalogued the sun's activities do not sound entirely helpful. Nevertheless I am an ardent heliotherapist, for in this method of treatment sun and air act together. The sun has been given all the credit. It is the old story, it pays to advertise! Expose a child to sun and wind, a coloured advertisement of the sun's action appears in the skin; in the public eye that settles it, the virtue must lie in the sun and the treatment is termed *helio*therapy. This is a little unfair to the wind. But it is equally unfair to the sun to assess his value on the effect of his undiluted activities, like whisky without soda. The violet end of the spectrum has been tremendously advertised because it produces the bronzed skin so much admired by the visitors to our hospitals, who think an almost naked child far less improper if he is deeply coloured; doubtless this dates back to the woad of our ancestors. But we should make sure of our ground before we single out photochemical action as the beneficial

agent, concentrate on its administration, and measure actinic activity as a guide to the value and the dosage of the sunlight. I am not yet convinced that the advantage of pigment is other than protective. Good pigmentation is a great help to a patient; for he can be exposed to sun and wind for much longer periods than others who have been unable or less able to protect themselves with bronze armour. But the very pigmentation has its dangers. It is the visible and obvious thing in heliotherapy, it catches the eye and diverts the mind. One danger is that it may divert the mind from a true conception of the help of the sun; another is that its degree may be taken as a *measure* of cure. For it is not a sign of recovery. It may be true to say that a good pigmenter has a better chance of cure, for he is in a position to gain more from sun and wind than his fellow; but it may also be true that a good pigmenter has less chance of cure if as a result of his appearance he is sent out of hospital too soon.

This brings me to a question of great importance in heliotherapy as concerned not with superficial lesions but with tuberculosis of bones, joints, and glands. Sunlight acts on the body in two ways; *photochemical* and *calorific*. These activities differ profoundly. Can we not learn how and when to use each?

Now we know certain things. In superficial tuberculous lesions, which present an entirely different problem, violet and ultra-violet light can attack the bacilli directly. In rickets on the other hand these rays have an indirect effect: here pigmentation is not a necessary concomitant, only small doses are needed, and the effect is excellent in unpigmented and non-pigmenting children and animals. In this condition photochemical action overcomes for the time being a diet or light deficiency from which the patient has suffered. Cod liver oil is equally effective. Is it not just possible that in deep seated tuberculosis, as in rickets, photochemical action and cod liver oil are only of value in cases where there has been a diet or light deficiency? Certainly the stimulating quality of light is helpful up to a limit, not yet defined. But where there is no such deficiency, has the exposure of the skin of the body to photochemical light any further value? Now I would put forward these points:—

1. The first step in heliotherapy is the carefully graduated exposure of the body in order to develop pigment: and until and unless pigment is developed only a small dose can be tolerated and more than a small dose is definitely harmful.

2.—Pigmentation, so far as is known, is definitely and merely a protection of the deeper layers of the skin and underlying tissues from the photochemical effect of sunlight.

3.—Sunlight contains both light and heat, a good skin takes prompt steps to stop the light as near the surface as possible. This is exemplified in the highest degree in the negro: in fact the better the skin and the more acclimatised the race, the more effective a barrier is erected against the photochemical action of sunlight.

4.—The better pigmented the patient, the more completely photochemical activity is cut out, and the better he responds to heliotherapy.

Doubtless we shall learn from physiological experiments more exactly how to use sunlight, and what artificial substitutes are best. It is already clear that for superficial lesions a source of ultra-violet light is necessary; this can be supplied artificially but in other forms of surgical tuberculosis the tungsten arc or the mercury vapour lamp are cold and relatively valueless substitutes for the warm sun. It is pleasant to feel that our temperate sun (when we have it) gives us all we need for bone and joint tuberculosis; and that our milder windier climate allows longer exposure and more stimulation of our patients' vitality than is possible under fiercer suns in hot or windless climates.

The Wind. While the sun warms steadily, the wind cools variably. The sun saves the patient from undue cold, the wind from undue heat. The combination is pleasurable, and like a contrast bath it promotes an active hyperaemia in the skin.

The wind is itself a great stimulus to metabolism. Leonard Hill says:—

> The heat production is kept at a high level as the children lie in cots in the open air, exposed to the wind and sun. Their heat production was put up something like 40 to 50 per cent. over children resting in a chamber, making the muscles strong and firm.
>
> 'In Montana the heat production of the resting subject was put up to a notable degree higher than was the case with the children at Alton in summer, but not higher than the latter on cold winter days.':[4]

The effect of the wind on the body is not wholly the result of cooling, —it would be a far less effective and pleasant form of treatment if that were so. There is unquestionably reflex stimulation on deep organs from the skin. We all feel the benefit of it after a run in the back of an open car or a walk on the hills on a windy day.

It has been shown that certain areas of the skin are in sympathy with certain viscera through a reflex arc. If stimulation of the small skin area supplied by Jacobson's nerve has an effect how much more will the wind blowing over large areas of skin affect all the associated viscera. *To sum up.* Wind and Sun are heaven-sent partners, neither can be used to the best without the other. Together they work in ways far beyond direct heliotherapy as a source of health and vigour, they stimulate and cheer us all and particularly patients in open air wards. Possibly, too, the partnership between sun and air may be more intimate than we know fully yet. The Vienna experiences suggest that one virtue of open air wards may lie in the effect on our patients of breathing air which is often sunny as well as always fresh.

The Skin. This organ is neglected by our profession. Its sensibility is recognised by fathers and schoolmasters as helpful to the formation of character. But we have been too much inclined to think of it merely as an excretory organ, or remember its other functions only sufficiently to apply a blister or a plaster.

Now Rollier says 'The skin is an admirable protection against the invasion of micro-organisms.'[5] Clearly the skin is our first line of defence against invasion of the body; and it is so effective in resisting bacteria that its efficiency is often forgotten. But, quite apart from the cuticle which it has developed as a physical defence, there is evidence that it plays an important part in our reaction to the Tubercle Bacillus. Both its sensibility and metabolism appear to share in this action.

Its Sensibility to variations of temperature and to the impact of moving air make it an important stimulant of heat production and other internal metabolism. It is thus a great factor in raising the vitality of the body.

Its Metabolism.—There are significant facts pointing toward the existence in the skin of a special power of counteracting the tubercle bacillus. May I quote from a short review of F. and A. S. Griffith and Eastwood's work which I published last year?

'In only 46 of the 1,068 cases already quoted do the strains of Tubercle Bacilli show any clearly marked alterations of virulence.

And in 44 out of the 46 the cultures were derived from cases where the skin was the main lesion. The only non-cutaneous lesions providing a strain of reduced virulence being, (1) a muscular or intermuscular abscess of the thigh from a girl aged 12, in whom a tuberculous cervical gland yielded a culture of standard virulence, and (2) a cervical tuberculous gland.'

'A. S. Griffith (*Journal of Pathology and Bacteriology*, Vol. xxiii, No. 2, February, 1920) discusses this most interesting matter, and states:

"The occurrence of attenuated strains of tubercle bacilli in scrofuloderma is of great interest and importance. Hitherto attenuated strains of tubercle bacilli have been found . . . . . only in lupus lesions, a tuberculous cervical gland, and an inter-muscular abscess. In lupus, which is caused by tubercle bacilli of human and bovine types in about equal proportions, the great majority of the strains have shown attenuated virulence. The presence of attenuated strains in the lesions of another variety of skin tuberculosis is, therefore, not surprising, and the difference in proportion of attenuated to standard strains in the two diseases is probably related to differences in the situation and duration of the tuberculous lesions. In scrofuloderma the tuberculosis affects primarily the subcutaneous tissues or the deeper layers of the skin and is of relatively short local duration, whereas in lupus the lesions are more superficial and of greater chronicity."

'The attenuation of tubercle bacilli is apparently then the rule in skin lesions. Is it not possible that there may be some very real relation between this reaction between the skin and the bacilli in lupus and scrofuloderma and the beneficial action of the sun and the wind in treatment? And may not this function be developed and used to a much greater degree?'[6]

Sir Robert Phillip has carried his out practically by the inunction of Tuberculin.

It is only fair to recognise that the skin is an organ of special sensibility very much concerned with the success of open air and sun treatment, and that there is some evidence that it has powers of reducing the virulence of tubercle bacilli which other parts of the body commonly affected by the disease do not possess.

I think most of us who are employed in this work feel strongly that good pigmentation carries with it a better prospect of sound and permanent healing. Pigmentation is a natural and advantageous response of the skin to photochemical light and *ipso facto* a sign of a good skin;

a skin capable of cutting out the violet end of the spectrum, capable also of gaining the best and most lasting benefit from other effects of sun and wind.

We talk of the Sun as the great healer and think little of our skin. Sun and wind may give the skin useful hints but it is the skin which interprets them to our advantage!

AN EPITAPH.

There is an experience which deserves special memory when the factors in the success of modern treatment are being assessed. Near the beginning of this century there was a short period when surgical tuberculosis was being treated in open-air hospitals without heliotherapy. Fresh from London I went to the open air hospitals at Baschurch and Heswall. What I saw broke upon my mind like a miracle. Pott's disease and hip disease had meant sadness and suffering, and I found a set of children as healthy and jolly as could be, and at Heswall I was told that not a case had been lost from lardaceous disease for two years. All this was accomplished without direct heliotherapy. I feel that this evidence is in danger of being forgotten and would suggest the following epitaph:—

Between the old days of white children and these days of brown children there was a decade or so when rosy cheeked children thrived in open air wards.

B.—*The local treatment of the affected parts.* Our aim is to give the part the rest it needs from strain and movement without constriction and to provide comfort, and stimulus to local circulation. It is necessary to decide first what degree of surgical rest is to be maintained and for how long; further whether there are stages for each of which a different degree of rest is appropriate; and finally to consider the principles of splintage (details would be out of place in a review of this type).

Again we have for our instruction a variety of aims and methods which we can examine and compare; and so define our purposes and make our plans. We have to consider the part that operation can take with advantage; whether mobility of joints should always be our aim, as Dr. Rollier teaches, or whether, with some degrees of disease, and in some joints, sound anchylosis in the best position is not a wiser goal. Once our aims are defined we want to be able to pick out those methods which will lead to sound healing with the best and most free use of the part, healing which will stand wear and tear and pass the test of time.

The splintage should:—

1. Hold the parts accurately and comfortably in whatever position is chosen.

2. Not constrict the circulation in the affected part.

3. Not interfere with respiratory movements.

4. Allow exposure of the affected part to sun and air and as much exposure of the rest of the body as possible.

5. In spinal caries, should allow full exposure of the back whenever necessary without risk of local strain or movement, and where bone destruction has made a local kyphos inevitable and desirable for the sake of sound healing and stability, it should be minimised and localised and compensatory curves should be developed.

6. Be as simple, inexpensive and widely applicable as possible.

METHODS OF IMMOBILISATION.

First let me take Shropshire as illustrative of the 'Liverpool School'; their practice is loyal to the Rule of H. O. Thomas—'Rest, enforced, uninterrupted and prolonged.'

When we remember that Thomas's father was a successful bone setter, and that before he was qualified he assisted his father for a year or two his very conservative methods have added significance. He came to the conclusion that the secret of success in the treatment of inflamed joints was rest with avoidance of local constriction. Rest was to include (a) *rest from movement*, and (b) *rest from pressure* whether due to muscular spasm or weight bearing. It was said to him, and the saying is common still, that prolonged rest favoured anchylosis; the answer he made was this: 'the treatment of articular inflammation by enforced rest never has been nor ever will be a factor in producing true anchylosis.[7]':

He favoured unremitting rest throughout the whole period of unsoundness, but was insistent on what he terms the secondary diagnosis, an ascertainment of the recovery of a joint so that it might be known when movement might safely be allowed. He put the matter thus:—

'But it has been overlooked that when we have detected the existence of abnormal conditions, we ought before releasing the patient from our control, to make a supplemental diagnosis and ascertain that there exists no longer any remnant of the ailment previously diagnosed. This secondary diagnosis is often very imperfectly made, consequently a relapse of the disease results, and either the treatment which may have

been very appropriate to the case, becomes discredited, or sometimes the patient, or part affected, is judged to be deficient of reparative power. I hope, in the following papers, to assist in giving such rules for primary diagnosis of defect and *secondary diagnosis of restoration* that their application to practice will show their utility. It is, in many instances, of equal importance to diagnose secondarily as primarily.'[8]

His rules for the secondary diagnosis of restoration may be put very briefly as follows:—When in the judgment of the surgeon all signs of active disease are safely passed, the splint is removed and careful records of the state of the joint are taken. If it is mobile the range of mobility is noted and especially such a measurement as that of the flexion deformity (if any) of the hip. If the joint is fixed the exact position of the joint is noted, to quote the hip as an example again, the actual and practical length measurements are recorded as well as the flexion deformity. The patient is allowed to be free in bed and at the end of a week the joint is again examined. In the mobile joint, if there is an increased range of movement all is going well, if a diminished range of movement the joint is not yet sound. In the fixed joint, if the previous position is maintained exactly all is well, but if there is a change the healing is still unsound. As a rule he repeated these tests for a month before considering them satisfied.

But Thomas was almost equally insistent against the constriction of an inflamed joint. He says that when joints are thus treated they 'are always long delayed in the unsound condition, and even when they improve they remain long hampered by some degree of false or unsound anchylosis.' He strongly disliked the use of plaster for fear of this effect. In this particular the Shropshire practice runs counter to Thomas's teaching, for plaster is used and possibly circumferential pressure on an inflamed joint does occasionally result. The advantages of plaster for certain conditions are great; and it is now technically possible in almost all cases to avoid danger of pressure, and to allow good exposure of the affected joint.

Shropshire, in my opinion, stands out as the model of immediate and absolute immobilisation. Their achievement in this line is undoubtedly magnificent, pain disappears at once or within a day or two, the inflamed joint is at rest, the patient's body is free from pain and his mind from apprehension of pain. But I think that joints are now and then 'delayed in the unsound condition,' and I know that in the past some of my own Wingfield cases have been 'long hampered by some degree of false or unsound anchylosis.'

At Alton, great care is devoted to the posture of the spine, and to weight extension of the joints with a view to mobility. The methods employed to attain these ends are such that immobilisation is less complete. *Rest from Pressure* is the main aim, absolute rest from movement is not so scrupulously carried out. In most cases the immobilisation seems sufficient but in the more acute type apprehension and pain persist for a time.

At Leysin splintage is not neglected. Plaster is little used, but is found helpful in the form of moulded back splints in which the limbs lie. These plaster troughs in their turn are often placed on wheeled trolleys which facilitate weight extension. Everything is designed so that the whole body may be exposed to the sun. *Posture and rest from pressure* are the principle aims in the methods of splintage employed.

Mobility is Dr. Rollier's aim in every instance. I have seen with him a joint in good position and with some mobility which had reached him deformed and anchylosed (of course the 'unsound' anchylosis of Thomas). In cases where radiograms do not show extensive damage of the joint and where one can expect the moving and weight bearing surfaces to be well adapted this is undoubtedly right, and the result magnificent: so too in the hip, where extreme bone destruction has produced a pseudarthrosis. But where the joint surfaces are much deformed the marriage of extensive disease and restricted movement is perhaps happy enough in hospital at Leysin, but, under the very different conditions of home, the wear and tear of life and the ups and downs of health will put the couple to such tests as I for one would not wish them to have to face. I feel this particularly in the case of the knee, and I think I am expressing a view common to most if not all British orthopaedic surgeons.

Dr. Rollier is a believer in stimulus to local circulation, he paints the joint with eosin dissolved in alcohol before sunning it, and in cases where synovial swelling persists uses the cautery or blisters. In awaiting and making the 'secondary diagnosis of restoration' Dr. Rollier is a model to us all; though he does not use Thomas's particular technique yet I feel sure Thomas would have delighted in his patience as he would at an earlier stage have been disturbed by his incomplete immobilisation. He uses his eyes and palpates the joint most carefully but pins his verdict to the evidence of healing shown in the radiogram. He put it to me thus:—'We let the patient up when the X-ray lets *us* do so.' The patient is allowed up very gradually and tentatively, and is kept under careful observation in hospital for a further 5 or 8 weeks.

We have found then divergences of aim and of method. In one

hospital mobility is always the goal, in every joint, however serious the disease and deformed the articulating surfaces.

So too in method there are schools of absolute immobilisation and of relative immobilisation.

Probably each school is right in some cases and at certain stages, but not in every case and at every stage.

My own belief is that during the period of active disease, characterised by pain and muscular spasm before splints are applied, or if they are inefficient, perfect surgical rest is indicated, and the splintage of the Thomas school is the best. But when all pain and muscular spasm are past, and muscles are no longer quick to resent, but ready to induce, minor movement of the joint, a second stage has been reached during which I believe the relative immobilisation of the Alton and Leysin school is best, with regard to joints where mobility can safely be aimed at. Watson Cheyne has put this view admirably:—

'The value of absolute mechanical rest' (he has mentioned recently both mobility and joint pressure) 'is so great and so universally acknowledged that one would think that in this matter at least there could not be any difference of opinion, and yet so eminent a surgeon as Scheda holds that complete immobilisation of tuberculous joints is a hurtful thing . . . and he asserts that the cessation of function of the joint leads to atrophy. . . . I think the question depends on the stage of the disease and its acuteness and that in the early stage absolute rest is requisite. At the same time it is very probable that the tendency is to immobilise the joint for too long a time and that after the disease has come more or less to a standstill a little movement, as apart from bearing weight on the part, may be a good thing in keeping up the nutrition of the tissues.'[10]

As soon as it is safe to permit that minor degree of movement which the methods of Alton and Leysin allow the body can be set more free.

At the end of treatment comes the 'Secondary diagnosis of restoration' and I am faithful to Thomas's tests of joint soundness aided greatly by first-class radiograms.

But in the meantime, as soon as the height of the disease is past, one must decide whether anchylosis or mobility is to be the aim. Where the disease and damage has been severe, in view of the general health and the work of the patient, anchylosis may be preferable to a damaged joint with some limited and not altogether safe mobility.

Except in the minority of cases where anchylosis is the aim, three stages can be distinguished:—

1.—*During active disease*—rest, enforced, uninterrupted.

2.—*During the stages of healing*—comparative immobilisation, rest from pressure but not from minor movement. Here the methods of Sir Henry Gauvain and Dr. Rollier attract me very much, and I am trying to apply them. I think they lead to better blood supply to the joint and they certainly help in the restoration of the muscles which stabilise and move the joint. In spinal caries in particular, Rollier's method of developing what he terms a 'dorsal muscular cuirass' is most attractive. I cannot help feeling that I have in the past been wrong in relying solely on the strict use of the support in these cases to the elimination of muscular development.

3.—*The stage of free use*, under careful supervision. During the convalescent and after-care stages, Thomas's tests should be applied again and again.

OPERATIVE METHODS.

For children under 16 formal operations are seldom if ever warranted, but in adults when disease is advanced, and a stiff joint is the best that can be hoped for and that only after several years' treatment, an excision will give a healed strong painless limb more quickly, more certainly and of sounder stability, than conservative measures; and furthermore without such excision recovery may be very long delayed, or the disease may gain ground.

Operative internal splintage by grafting bone or by osteoplastic methods has in my opinion very real value in spinal caries in adults. I have reviewed this subject recently.[11]

Cold Abscess.—At Alton, Sir Henry Gauvain aspirates frequently and often injects alterative or antibacterial fluids. But at Shropshire and Leysin an abscess is only aspirated if it threatens the skin. A fine needle is used; no determined effort to empty the abscess is made; as a rule, nothing is injected. Sir Robert Jones has always taught that the fluid in a cold abscess is harmless: Dr. Rollier is equally convinced. To open and drain a cold abscess is to commit a surgical crime. Dr. Rollier puts the matter picturesquely: he labelled such a surgeon 'catastrophic' and said it was 'almost a condemnation to death, not at once, but in two or three years.' He added, 'we cannot struggle too much against it.'

Besides all these things, there are many points of technique suitable for a demonstration but too confusing to include in a review such as this.

I have tried to make the main issues clear. A tuberculous focus in a bone or a joint is the obvious part of a deep-rooted disease, serious in itself, crippling if there is delay, disastrous if there is neglect; but it is also evidence of tuberculous infection of the body which pre-existed but is now gaining the upper hand. On the other hand, modern treatment with its artistic use of rest, food, and weather, if started in good time and kept up long enough will almost always bring about a cure: a cure that skilled after care will make permanent. Thus the crippling and the disaster can be forestalled, and a lifetime of health and activity take their place. We have seen that this treatment necessitates a special open air hospital and a staff experienced and technically expert; but there is no need to transplant a patient from his home climate to a distant hospital.

Rather is a hospital in the district twice as good as one in the distance, for it will admit its patients early, follow them home when they go out, take watchful care of them, and spare no effort to make their cure complete and final.

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A SURVEY OF THE OCCURRENCE OF COMPRESSION PARAPLEGIA AND POTT'S DISEASE WITH COMMENTS ON THE TREATMENT OF THE PARALYSIS.*

BY CHARLTON WALLACE, M.D., NEW YORK, N. Y.

Professor of Orthopaedic Surgery, Cornell University Medical College, New York City

Associate Surgeon and Chief of Out-Patient Department, Hospital for the Ruptured and Crippled

This is a study of the complication of compression paraplegia of Pott's disease occurring at the Hospital for Ruptured and Crippled during the years 1899 to 1909 and of the relative value of the Calot jacket in lessening the period of paralysis. A few facts will also be presented concerning the annual occurrence and incidence of Pott's disease, extending over a period of twenty years, as observed in the Out-Patient Department. The author is under obligation to Dr. George W. Bennett for having suggested this paper and for his able and untiring assistance in assembling the data on compression paraplegia while he was an interne at the hospital.

By compression paraplegia is meant a paralysis due to a constriction or a pressure upon the cord, which, if not relieved, may cause an acute or chronic inflammation within the spinal canal, with all of its destructive elements. Pott's disease is the most potent factor in causing this condition.

The tuberculous osteitis generally starts in the body of the vertebra, more or less destroying it, and the caving-in of the front support of the spinal canal takes place. If this destruction is severe, then the resulting deformity is correspondingly great. The pressure on the cord, which is of interest to us, may be caused by granulation tissue, abscess, a slipping of the vertebrae upon which the cord may be impinged, or the disease may penetrate the dura and pia, thereby causing a true myelitis.

* Read at the Annual Meeting of the American Orthopedic Association, Rochester, New York, May, 1923.

For the pathology we wish to quote Dr. Stearns, who did a post mortem examination and microscopically examined a pathologic specimen from a patient with paralysis who died at the Hospital for Ruptured and Crippled in 1896.

"The cord just above the curvature shows a sclerosis of all areas of white matter, least in the posterior columns and greatest in anterior columns, and direct cerebellar and Gowers' tracts. Moderate in the crossed pyramidal, anterolateral and mixed lateral tracts. Below the curvature there is much less sclerosis generally, but the posterior columns and the descending antero-lateral tract are almost completely destitute of nerve fibres, while all of the anterior and remainder of lateral columns present only very moderate evidences of sclerosis. These central lesions are decidedly confused as to their distribution, which is partly, at least, accounted for by a considerable amount of productive inflammation under the dura mater for about two inches in the region of the curvature. There are also some small patches of new formation, sub-meningeal, above and below the curvature. These latter are isolated, and, of course, would give rise to some of the otherwise unexplainable areas of degeneration and sclerosis[1]."

The diagnosis is made from the history, the symptoms manifested and the examination of the reflexes. The Pott's disease is usually self evident, but occasionally the paralysis is the first symptom of the tuberculous affection of the back-bone. The gait becomes weakened and soon the power of motion is lost. This may happen soon after the development of the bone lesion, or several months may intervene. The reflexes below the lesion are exaggerated. The increased knee jerk and appearance of ankle clonus are developed early. There may be loss of control over bladder and rectum. Some few cases have areas of paresthesia or anesthesia, but these are rare. The majority of patients recover, some remain permanently paralyzed, while a few die. Of course recovery is out of the question when a true myelitis exists.

The treatment, of course, is to prevent the paralysis. It is our belief that no case of paraplegia, secondary to Pott's disease, would occur, if the orthopaedic treatment were thorough. When the complication does appear, the patient should be put in the recumbent position until some evidence of return of power is shown and the exaggerated reflexes at the knee and ankle have subsided. The hyper-extended Bradford frame, with head and feet traction, is the best non-ambulatory treatment, except one. If not this one, then confine the patient to bed, with extension apparatus attached.

The operation of laminectomy for paralysis following Pott's disease is so seldom performed that it is not considered in this paper, except to quote the late Dr. De Forest Willard, with whom the author agrees. "Prognosis in pressure paraplegia is hopeful unless the cord has been actually destroyed. Laminectomy for spinal caries paraplegia should never be undertaken until at least one year of persistent treatment by rest, fixation and extension (together with alteratives, etc.) has been most patiently tested[2]."

FIG. 1.
Fenestrum over kyphos for pressure block.

The following statistical information was obtained from our study:

In a total of 1649 new cases of Pott's disease treated at the Hospital for Ruptured and Crippled during the years 1899 to 1909 there occurred seventy-nine cases of paraplegia or a 4.7 per cent. proportion. Taylor and Lovett[3] reported 13 per cent. proportion, and Gibney[4] 21 per cent. proportion of paralysis in patients afflicted with Pott's disease.

The caries was located in the middle or upper dorsal region in sixty-four patients, in the cervical segment in eleven and in the dorso-lumbar

vertebrae in four. The deformity was severe in thirty-six, moderate in thirty-four, slight in five, absent in one, and not recorded in three. The character of the deformity and the site of the lesion evidently were potent factors in causing the loss of power.

The paralysis affected the lower extremities in seventy-two patients and the upper and lower extremities in seven of them. There was loss of bladder and rectal control in fourteen and anesthesia existed in four patients; analgesia and aphonia were found in one.

FIG. 2.
Hooks for traction on pressure block.

In this study the time regarding the duration of Pott's disease previous to the existence of the paralysis was recorded on only fifty-six charts. The paralysis occurred in thirty patients during the first year, sixteen during the second year of the caries. The Pott's disease had existed in the other ten patients for from three to eleven years before any signs of paralysis were seen. The average duration of the Pott's disease was about nineteen months.

Fifty-five patients received treatment for the caries before the paralysis developed and twenty-four had no treatment.

Six patients of the seventy-nine refused treatment, and of the seventy-three receiving therapeutic attention eleven died, five were not benefited, one was improved, and fifty-six were cured of the paralysis. Thus 76 per cent. of the treated patients were cured of the paralysis as compared with 60 per cent. of the cures obtained by Dr. Gibney.

The duration of the paralysis before recovery took place in the fifty-six patients that did get well was, 3 months for seventeen, 3—6 months for eleven, 6—9 months for six, 9—12 months for six, 12—15

FIG. 3.
Pressure block in place over kyphos.

months for three, 15—18 months for three, 18—24 months for four, 2—3 years for four, 3 years and over for three.

Forty-five of these patients were treated with other orthopaedic appliances than the Calot jacket, and the average duration of the paralysis for these was 10.2 months, while the average duration of the paraplegia of the eleven treated with the Calot jacket and pressure pad was 4. 9 months.

Various back braces and plaster-of-paris jackets with head supports have been used in the treatment of Pott's paraplegia but the results

obtained with the Calot Grand plaster-of-Paris jacket with a pad making constant pressure on the kyphos, influence one to endorse and recommend this method as the best in curing the paralysis of Pott's disease, as well as favorably affecting the deformity.

We at the Hospital for Ruptured and Crippled have been under the impression that the occurrence of bone tuberculosis had greatly lessened in recent years, and in order to satisfy ourselves concerning this, a careful analysis of the records of Pott's disease over a period of twenty years has been made.

No patient's chart has been included in this study if there has been the least question of diagnosis. The following table requires no explanatory comments to this scientific body of surgeons; but one may be pardoned for making a few observations which seem pertinent. Only those patients applying for treatment for the first time in the Out-Patient Department at the Hospital for Ruptured and Crippled have been included: in other words, for us they were new cases.

Beginning with October 1, 1899 and ending with October 1, 1919, it was found that there had been 148,270 new patients treated at the Hospital for Ruptured and Crippled. Of this grand total, 2,464 were cases of Pott's disease. In comparing the figures of the total number of new patients with the total number of cases of Pott's disease, one finds that there has been a remarkable decrease in the number of patients with tuberculosis of the spine, while on the other hand there has been an increase in the number of new patients treated in the Out-Patient Department of the hospital. Therefore, one is forced to conclude that Pott's disease is considerably on the decline. This relative diminution is especially noticeable during the last five years, when less than one-third as many cases appeared during this time than occurred during the first five years of our study.

The age incidence is of some interest. Eight per cent. of the cases were adults, and of the remainder 71 per cent. were below the age of six years.

From the foregoing the following conclusions have been derived:

1. Paralysis rarely developed when the focus of disease was below the tenth dorsal vertebra or when efficient orthopaedic treatment and care had been administered.

2. The Calot plaster-of-Paris jacket with pressure pad of plaster-of-paris bandage and cotton, or Bennett's felt pressure block, offers the best and surest method of a cure of the paralysis, as well as the greatest promise to cut short its duration and reduce the deformity.

3. The improved method of the treatment of Pott's disease and its early diagnosis have acted as a control in preventing the paralysis. This Association's members have been the pioneers and leaders in the campaign of teaching the medical profession the recognition of Pott's disease prior to the development of deformity: also that the contact of a child with pulmonary tuberculosis may be the source of the bone and joint infection.

4. There has been manifested a decrease in the occurrence of Pott's disease, which might warrant one in inferring that other forms of bone tuberculosis have correspondingly diminished in New York City. A complete eradication of this infection may not be expected but the minimum appearance of this deforming disease is being rapidly approached. The author believes that this is accounted for in either or both of the following ways.

a. Through the therapeutic and prophylactic programs as carried on by the various health and philanthropic organizations of New York City especially interested in combating tuberculosis.

b. By having the child's resistance to this disease raised to a maximum through the numerous activities of infant dietetic, hygienic, and child welfare organizations.

TOTAL NUMBER OF NEW PATIENTS TREATED IN THE OUT-PATIENT DEPARTMENT OF THE HOSPITAL FOR RUPTURED AND CRIPPLED FROM OCT. 1, 1899 TO OCT. 1, 1919.

Year	*Number of New Cases*		*Number of Pott's Cases*
99–00	4781		
00–01	4897		
01–02	5521		
02–03	6687		
03–04	6302	28188	895
04–05	6453		
05–06	6633		
06–07	6971		
07–08	7916		
08–09	7847	35720	764
09–10	9361		
10–11	8020		
11–12	7914		
12–13	7543		
13–14	7489	40327	534
14–15	7934		
15–16	8157		
16–17	8883		
17–18	9843		
18–19	9218	44035	271
	Grand Total	148270	2464

THE ANALYSIS OF THE OCCURRENCE AND INCIDENCE OF POTT'S DISEASE AT THE HOSPITAL FOR RUPTURED AND CRIPPLED.

FROM OCT. 1ST 1899 TO OCT. 1ST 1919.

YEAR	L	D	C	M	F	AGES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Adult	T'l
99-00	48	127	9	108	76	9	37	30	26	18	12	3	10	3	6	1	2	0	0	2	2	0	23	184
00-01	43	126	7	95	81	9	41	32	26	16	12	10	8	3	5	1	1	0	1	0	1	2	8	176
01-02	46	115	10	88	83	7	36	32	26	26	13	6	1	4	4	0	1	3	1	2	3	0	6	171
02-03	42	117	14	99	74	4	37	40	26	20	10	8	3	6	5	2	1	1	2	0	1	0	7	173
03-04	54	125	12	98	93	12	37	33	29	19	24	7	5	5	3	0	3	1	2	0	1	2	8	191
04-05	39	95	10	77	67	8	40	27	22	15	9	4	5	1	3	1	1	0	1	0	1	0	6	144
05-06	39	102	10	96	55	12	30	35	20	10	7	6	3	0	3	0	2	2	2	1	0	2	16	151
06-07	31	115	7	72	81	8	32	32	18	13	11	8	5	1	13	2	0	0	2	1	0	0	7	153
07-08	41	115	11	85	82	9	41	46	16	11	11	6	4	0	2	0	3	0	2	1	3	0	12	167
08-09	39	101	9	83	66	18	33	31	20	18	5	2	1	2	2	2	0	1	2	0	0	1	11	149
09-10	34	97	8	72	67	11	24	36	14	9	6	5	5	2	5	1	2	1	1	2	1	2	12	139
10-11	21	86	8	63	52	10	24	21	10	11	6	4	4	3	2	4	2	2	2	1	1	0	8	115
11-12	27	85	2	67	47	7	17	23	22	21	7	5	2	1	0	0	2	1	0	0	0	0	6	114
12-13	24	62	2	42	46	4	16	22	20	8	4	3	1	0	1	0	0	2	0	0	1	0	6	88
13-14	27	49	2	39	39	2	14	14	10	12	9	2	2	1	1	1	1	2	0	0	0	2	5	78
14-15	17	58	2	44	33	7	13	19	14	4	6	3	1	0	1	0	0	0	1	0	1	0	7	77
15-16	20	47	1	36	32	4	13	15	11	2	6	3	1	0	1	1	1	0	0	0	0	1	9	68
16-17	16	22	4	14	28	2	3	14	4	2	5	3	1	0	1	0	0	0	0	1	1	1	4	42
17-18	10	35	1	29	17	2	6	9	8	4	7	3	0	0	2	1	1	0	0	0	1	0	2	46
18-19	9	25	4	15	23	3	8	7	2	5	2	2	2	0	0	1	1	0	0	0	0	1	4	38
	627	1704	133	1322	1142	148	502	518	344	244	172	93	64	32	60	18	24	16	19	11	18	14	167	2464

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DISCUSSION OF PAPER OF DR. WALLACE.

Dr. David Silver, Pittsburgh, Penna.: Dr. Wallace's conclusions in regard to the lessened frequency of Pott's disease are most interesting and in accord with reports of the frequency of tuberculosis in general. However, at the present time there is a possibility that some of the other clinics in New York might show a higher percentage of cases of spinal tuberculosis owing to the popularity of the operation for spinal ankylosis.

The prognosis of paraplegia due to Pott's disease depends on the cause of the paraplegia. If there is a simple compression paralysis, due to narrowing of the lumen of the canal by the kyphosis or to oedema of the cord, naturally any of the accepted methods of treatment should prove effective, and this type of paralysis may be expected to clear up fairly quickly. On the other hand, when the paralysis is due to extension of the tuberculous process into the canal,—abscess in the canal or pachymeningitis,— the problem is an entirely different one and recovery is going to be a very slow process. In these cases the general treatment of tuberculosis becomes particularly important.

In the last few years my views regarding the treatment of tuberculosis of the spine in children have become very definite. I believe there are three measures of particular importance: first, fixation; second, recumbency *until the radiograms show bony consolidation of the affected vertebrae*; and third, heliotherapy. The type of fixation to be employed must be one which affords easy access for heliotherapy, and naturally a plaster cast of the bi-valve pattern, on the order of the Calot jacket shown by Dr. Wallace, will generally be found most suitable. The recumbent position is not alone the only satisfactory one for obtaining correction of the deformity but also the only certain one for relieving the diseased vertebrae from harmful pressure. I have been much impressed by the comparative ease with which we can secure absolute correction of the deformity (in the earlier course of the disease) by extreme hyperextension and fixation, and by the satisfactory manner in which the affected vertebrae will consolidate under continued recumbency and heliotherapy. Several years' recumbency may be required before bony ankylosis is secured and this may seem to many too trying and expensive a method, but I am convinced that it is both the best and the most economical in the end. Any method which promises a straight spine with bony consolidation of the affected area, in a larger percentage of the cases at least, is well worth while even if it does seem long and tedious. Heliotherapy has impressed me as being of unusual value, and as being particularly useful where the disease has extended into the canal,—that is, when there is an abscess, either liquid or cheesy, in the spinal canal, or an external pachymeningitis.

One other point that requires most careful consideration is the advisability of an ankylosing operation in the presence of paraplegia. I have seen paraplegia develop a year after a successful ankylosis by the Hibbs method. In this case there must naturally have been a direct extension of the tuberculous process to the canal. It seems to me that any ankylosing operation in the presence of paraplegia is a mistake. Sufficient fixation of the diseased area can be secured without operation. To subject the patient at the time he has a paralysis, provided it is due to the extension of the disease to the canal and not to simple compression, to the strain on the general constitution from operation is, in my experience, unwise. I have not seen any benefit result from it and I have seen harm.

Dr. Robert B. Osgood, Boston, Mass.: I am not sure that we should dismiss so completely the question of laminectomy in the occasional case of paraplegia. If you look at the book of Frazier on the spine you will see a beautiful illustration of tuberculous tissue pressing on the cord that would not seem possible to remove by fixation or extension. We have had recently two cases of very obstinate paraplegia which were not improving under perfect fixation as far as we were able to apply it. In the first case in which laminectomy was performed by Dr. Jason Mixter a large amount of tuberculous matter presented extradurally, pressing directly on the cord. The removal of this made a very definite improvement in the patient's condition. In the other case at the Children's Hospital the laminectomy was done by Dr. Cushing. Two little abscesses were found pressing directly laterally on the cord with pressure on top of the cord as well. These cases have been definitely relieved by laminectomy. Neither of these cases showed any material shock, though one was in very serious condition before the operation. There may be danger in too forcefully hyperextending the spine. Undoubtedly one can correct the deformity, but one must remember the very careful work done by Dr. Schwartz and the principles he worked out for safe hyperextension.

I quite agree with Dr. Silver that heliotherapy is very important. The frame devised by Dr. Schwartz so that any degree of extension can be exerted at any level whatever is a very satisfactory appliance as we have used it at the hospital.

Dr. Walter Truslow, Brooklyn, N. Y.: Dr. Wallace has raised the question as to whether tuberculosis of the spine is not decreasing. I have no figures at hand, but simply my personal testimony that tuberculosis in my section is decreasing. I believe that Dr. Wallace's reasons are correct: better hygienic conditions of the large communities.

The question of relieving paraplegia by whatever method we have is probably best accomplished by early recumbency on a Bradford frame or some modification. This usually will quickly relieve the condition.

Dr. David Silver, Pittsburg, Pa.: I was speaking of ankylosing operations on the spine and not of laminectomy. I quite agree with Dr. Osgood about laminectomy.

Dr. J. T. Rugh, Philadelphia, Pa.: I take issue regarding the dictum of operation on a spine in state of paralysis and I do that because of personal experiences. I have had a number of cases in which I did an ankylosing operation with the very best results, two of which I distinctly recall; one where the lesion was in the lower cervical region. The man had been confined to bed for about a year. He had absolutely loss of control of the sphincters and of the lower extremities. A bone graft placed in this area resulted

in complete restoration, and a year and a half afterwards he was working as a driver of a wagon in the street cleaning department in the city. Another case was in one of the camps in the South, a man with a very acute process. He had two large psoas abscesses and a total paralysis. A graft was placed in the dorso-lumbar region, and three months afterwards he began to regain power in the lower extremities and went on to complete recovery. I see no reason from my own experience for postponing the ankylosing operation in these cases of paralysis.

Dr. W. E. Gallie, Toronto, Ont., Canada: In listening to Dr. Wallace's paper I was struck with the evident difference between his conception of the cause of paraplegia and that of the majority of surgeons. He seems to suggest that paraplegia usually results from bony deformity, whereas the most commonly accepted view is that it results from pressure on the cord produced by inflammatory materials, and usually an abscess.

A short time ago a case of paraplegia was under discussion in my service and we wrote to a group of surgeons to get their opinions as to the best form of treatment. Sir Robert Jones replied by quoting a saying of Thomas to the effect that he thought the presence of paraplegia was an excellent thing, as it kept the patient quiet and gave the diseased spine an opportunity to heal. He said he did not consider the onset of paraplegia a serious thing, as the great majority recovered completely under suitable treatment. He did not think operative treatment necessary or wise. Calvé has an entirely different idea in that he thinks the compression of the cord should be relieved by the introduction of a cannula into the abscess. He reports satisfactory results from his special method. He condemns laminectomy and costo-traversectomy because they not infrequently result in tuberculous sinuses. Dr. Whitman agreed with Sir Robert Jones that operations of any kind are usually unnecessary and, therefore, unwise. For a case of long standing, however, he would not hesitate to try a laminectomy. Osgood answered as he did to-day. Putti said that he considered all operations unwise except the cannula method of Calvé, which had given some good results in the few cases in which he had tried it. Mr. Dunn of Birmingham thought operations were unnecessary. John Fraser of Edinburgh, on the contrary, is enthusiastic for the operative treatment and recommends an operation of his own which will be published shortly. He reports fifteen cases operated on with rapid recovery in all except one. Our own impression agrees with the opinion of the majority that it is unwise to operate, as recovery can be anticipated in nearly all cases if they are effectively immobilized in a recumbent position.

Dr. George R. Elliott, New York City: Dr. Spellissy referred to the question of time. This can be answered with a degree of certainty. The cord becomes mechanically injured and often destroyed by pressure. The lesion—an external caseous pachymeningitis settled some thirty years ago is as well understood as the intestinal lesion of typhoid fever. I have verified this from examination of a large number of pathologic specimens coming under my observation. The effect on the cord varying from an oedema to complete destruction and its conversion into fibrous tissue at site of pressure. Treatment as shown by Dr. Wallace with the Calot jacket or any method of complete fixation is in a very large percentage of cases followed by relief. This should follow soon; certainly after a few days there should be improvement. Proper interpretation of clinical findings tells the story. In pressure paralysis the rule is first motor loss, then sensory, in the following order: pain, temperature, and finally tactile. Improvement follows in the reverse order. Tactile sensation is seldom lost. If it is

lost with complete loss of reflexes—knee jerks and Babinski,—little can be hoped for by any operative procedure. More than once I have seen patients operated upon after the reflexes have disappeared. This loss means the cord has been destroyed and operative procedure in form of laminectomy or spinal fixation will do no good. Surgeons who cut down upon the spinal cord to relieve the paralysis when the reflexes are gone, together with tactile loss, do an absolutely useless operation from the paralysis standpoint.

A large experience in treating these cases with the Calot jacket and other means of complete fixation has taught me to expect recovery. But if relief does not follow very soon—a matter of days—and the sensory symptoms increase while the reflexes gradually diminish, operation is clearly indicated. Why wait?

DR. CHARLTON WALLACE, New York City (closing the discussion): One is very greatly gratified with the discussion that was brought forth, though I am not in accord with some of it. My thanks are extended to Dr. Silver for having gone into the treatment of Pott's disease. The treatment of Pott's disease was purposely omitted and one agrees with Dr. Silver in what he said concerning its treatment, but he has not convinced me that bone tuberculosis is not on the decline, especially in New York City.

Dr. Osgood reported two cases of operation. The literature reviewed by me gave the opinion of the majority, especially the late Dr. De Forest Willard, Sr., who said he had long since stopped doing operations for paraplegia because of the great mortality and disappointing results obtained by laminectomy. In my opinion the operation of laminectomy should be the thing last resorted to. The microscopic pathology if one wants to review it thoroughly may be found in an article published by Huddleston in the American Journal of Medical Sciences, Vol. CVIII p. 163. He found that the pathology ranges from spicules of bone sticking into the spinal cord to granulations around the pia and very definite myelitis.

I want to thank Dr. Gallie for his review.

A CASE OF MULTIPLE BONE LESIONS OF ATYPICAL ROENTGENOGRAPHIC APPEARANCE WITH THE PATHOLOGIC FINDINGS.

Multiple Tuberculous Osteomyelitis With Both Formative and Destructive Lesions.

BY CHARLES L. BROWN, M.D. AND DANIEL M. STIEFEL, M.D., BOSTON, MASS.

From the Department of Pathology of the Harvard Medical School and the Orthopaedic Clinic of the Children's Hospital.

In 1920 Lovett and Wolbach[1] reported twenty-five cases of bone lesions occuring in the Orthopaedic Clinic of the Children's Hospital, of Boston. In this paper they emphasized the difficulty in differentiating by the roentgenographic appearance between the three common groups of bone lesions: namely, pyogenic osteomyelitis, tuberculosis, and syphilis. They pointed out that from the radiographic point of view the reactions of bone to pathologic conditions could be classified as (1) "atrophy, or diminution in lime content," (2) "destruction of bone tissue, local or general," and (3) "a formative process, characterized by formation of new bone or a condensation of existing bone around a focus of disease." That the three diseases mentioned above may share these reactions in varying degree, and that a type of reaction usually associated with one might be shown by either of the others, was apparent from a study of the roentgenographs, together with the pathologic and clinical evidence.

A case occurring recently in the Orthopaedic Clinic of the Children's Hospital seems to illustrate this very well. A child, with a history of exposure to a tuberculous father, developed multiple bone lesions. This history of exposure to tuberculosis, a positive von Pirquet reaction, a positive intradermal tuberculin reaction, and the clinical and roentgenographic findings in the lungs seemed to warrant the diagnosis of tuberculosis. The roentgenographs of the bone lesions, however, were so different from the appearance usually associated with tuberculosis, and so similar to the appearance usually associated with syphilis, that it was the consensus of opinion to diagnose the case as one of tuberculosis and congenital syphilis combined.

Case Report.

E. S., a girl one year and eight months of age, was admitted to the Children's Hospital on January 16th, 1924.

Family History: Father has pulmonary tuberculosis.

Past History: The child had whooping cough in March, 1923. Otherwise negative.

Present Illness: The child was apparently well in every way until March, 1923, when she developed whooping cough. The father, who is now in a sanatorium for tuberculosis, took care of the child during her illness. During the nine months before admission she developed, in succession, draining sinuses in the left lower thoracic region, the right sacro-iliac region, the left ankle, and the left wrist. A short time before admission a fluctuant mass appeared in the right posterior triangle of the neck. The mother stated that the child had been gaining weight during the two months before admission, that she slept comfortably, and had a good appetite; also that the child coughed when crying.

Physical Examination: The child appeared well nourished, but flabby. In the right posterior triangle of the neck there was a rounded mass about 3 cm. in diameter. The skin over the mass was of normal color and not adherent to the mass. There was no increased local heat. There was a definite sensation of fluctuation obtained on palpation. The tonsils were moderately enlarged. The lungs showed impaired resonance to percussion. There was a scar of a recently healed sinus over the left lower thorax. The abdomen showed nothing abnormal. There were draining sinuses over the lower end of the left ulna, the lower end of the left fibula, and over the right sacro-iliac region. The joints in the neighborhood of these sinuses showed some limitation of motion, and passive motion seemed to elicit some tenderness. No signs of effusion into the joints. The child coughed while crying.

The urine was normal. The blood showed a leucocyte count of 11,800, with the following differential count: polymorphonuclears 76 per cent., lymphocytes 16 per cent., mononuclears and transitionals 8 per cent. The von Pirquet reaction and the intradermal tuberculin reactions were positive. The blood Wassermann reaction was negative.

X-ray Report (Dr. C. Liebman): A roentgenogram of the chest showed a diffuse mottling and some consolidation of the right upper lobe. There was haziness over the left lung. The appearance was suggestive of tuberculosis. Films of the upper extremities showed an extensive periosteal reaction along the shaft of the right ulna, and a very marked periosteal reaction with some destruction in the lower end of the shaft of the left ulna, and a slight periosteal reaction along the shaft of the left radius. The metacarpals did not appear to be involved. A film of the lower extremities showed a rather diffuse periostitis along the shafts of both tibiae and a definite destructive process in the lower end of the left fibula. There was no joint involvement. In view of the multiplicity of the lesions and the definite periosteal reaction, the process suggested congenital syphilis.

The temperature, which on admission was 99.8° F. (rectal), rose to 103° F. the next day and continued to rise higher. The child's general condition, which on admission was not alarming, quickly became poor. A condition of great toxicity quickly became apparent. On the third day after admission the temperature rose to 106° F. and the patient died.

AUTOPSY FINDINGS.

Pleural Cavities: The left was negative. The left lung was partially collapsed when the thorax was opened. The right pleural cavity was entirely replaced by fibrous adhesions, which were very dense and could not be broken apart at the apex. Over the anterior surface of the right lower lobe there was a cavity with hyperemic, roughened walls and partially filled with yellowish-white purulent material. Its capacity was about 10 c. c. It seemed to be entirely formed by the pleural area and was contiguous with the lung tissue by three deep channels that probably represented bronchial structures. However, when these were probed they seemed to lead into blind pockets in the superficial lung tissue. The diaphragm was firmly adherent to the base of the right lung.

Lungs: The right weighed 90 grams. The lung tissue was mottled light and darker red, and there were irregular, light red areas in the lower part of the upper lobe. Most of these areas were well anterior, and in some places the color merged into pinkish-white, representing alveolar emphysema. There was a generalized fibrosis, as was manifest by the density and cutting resistance of the lung tissue. This was true especially in the tissue near the hilus and in the upper part of the upper lobe. Cut surface showed irregular grayish-red, apparently solid areas, often near bronchi. A few minute whitish areas were seen scattered in the denser tissue. No cavities, other than the one described under "pleural cavities." No large areas of caseation. The left lung weighed 68 grams. The lung was mottled light and darker red, the darker coloration being in the posterior portion of the lung. The lung was crepitant throughout but felt a little "boggy" in the darker portion. There was some alveolar emphysema anteriorly. Cut surface showed the same color effect, and a small amount of sero-sanguineous fluid exuded. Scattered here and there on cut surface a few minute grayish white-areas were seen. There was very slight increase in the cutting resistance of the lung tissue. There were no cavities or areas of caseation. Microscopic examination of both lungs showed many small typical tubercles, some with caseous centers. In addition, the sections of the right lung showed the formation of tuberculous granulation tissue, fibrosis, and regeneration of the alveolar wall epithelium in some places.

Mediastinum: The thymus weighed 8.5 grams and was negative in appearance and consistency. The mediastinal lymph nodes were moderately enlarged and reddened. The hilus nodes on the right were more markedly enlarged and one of them showed an area of caseation, 1 to 1.5 cm. in diameter. Microscopic examination showed tuberculous lymphadenitis.

Pericardial Cavity and Heart: Negative.

Peritoneal Cavity: Negative.

Spleen: Weighed 25 grams. Capsule smooth. It was deep bluish-red in color and normal in consistency. A few small, diffuse, barely visible, whitish areas were seen on superficial surface. Cut surface was negative. Microscopical examination showed acute splenitis, manifest by pale staining splenic nodules in which there was large mononuclear proliferation, and some showed necrosis. There was some proliferation of the endothelial cells lining the reticulum, and many polynuclear leucocytes were seen in the pulp. No tubercles were found.

Liver: Weighed 345 grams. It was reddish-brown in color, mottled slightly with yellow. Borders were fairly sharp. Cutting resistance not increased. Cut surface

showed same color effect, with distinct markings. Microscopic examination showed a few miliary tubercles and fatty degeneration changes.

Gastro-intestinal tract, Gall-bladder, Bile Ducts, and Pancreas: Negative.

Kidneys: Both weighed 80 grams. Capsule stripped easily, leaving smooth kidney substance. Kidney tissue was rather pale but of usual consistency. In the upper pole of the left kidney there was an area of caseation, 0.8 cm. to 1.0 cm. in diameter. No other areas of caseation or tubercles seen. Cut surface of both kidneys was otherwise negative. Pelves and ureters negative. Microscopic examination showed the above area of caseation to be a focus of tuberculosis.

Adrenals, Bladder, Genitalia, Aorta, and Organs of Neck: Negative.

Examination of the head was not permitted. Spinal fluid obtained at post-mortem examination by lumbar puncture, was negative.

The fluctuant mass in the right side of the neck, described in the case report above, proved to be a tuberculous abscess (inoculated guinea-pig positive for tuberculosis).

Old discharging sinuses were present in the following places: (1) one in the right sacro-iliac region, 0.5 cm. in diameter, (2) over the left fibula, just above the external malleolus, the sinus and scar tissue involving an area 5.0 cm. by 1.0 to 2.0 cm., and (3) one on the palmar surface of the left wrist, over the lower end of the ulna, 1.0 cm. in diameter.

The right tibia showed subperiosteal thickening in the lower one-third, as demonstrated in the radiograph (Figure 1). The periosteum was entirely intact and seemed slightly thickened. The new subperiosteal bone was pinkish-white in color and was present the entire circumference of the bone, being a little more than a millimeter thick in some places. It could be cut through by very heavy pressure on the scalpel. The old cortical bone was a little darker in color with a grayish tinge, and averaged almost a millimeter in thickness. The marrow and the line of ossification appeared negative.

The left ulna was thickened at either end in a bulb-like manner. The periosteum was slightly thickened and its continuity was impaired at the point of association with the sinus mentioned above. A shell of new subperiosteal bone was manifest in most places over the surface as a thin, slightly lighter colored, less dense, bony structure. The differentiation of the old and new bone was not so clearly-cut here as in the right tibia. The marrow cavity contained many bone spicules, and aside from slightly different consistency of the marrow tissue in some places, appeared negative. At the lower end of the ulna there were definite destruction of the bone and red granulation tissue formation that were continuous with the sinus described above.

The gross appearance of the remaining bone structure of the left fibula at its lower end was much the same as that described in the ulna. However, there was a much more marked destruction with granulation tissue formation associated with the sinus formation. A white, soft sequestrum filled the lower end of the marrow cavity.

Microscopic examination showed foci of tuberculous osteomyelitis in all of these bones; sequestrum formation, destruction, and the very striking formation of new subperiosteal bone were observed. These bone lesions were of especial interest, and it is with these that we wish to deal in detail.

Figure 1 shows a radiograph of the right tibia in the antero-posterior view, demonstrating the subperiosteal new bone formation. A complete cross section taken at the level of the arrow is shown in figure 2. This section shows several typical small tubercles (see arrows in figure 2) and the formation of tuberculous granulation in the marrow. The old

FIG. 1.

Roentgenogram of right tibia, antero-posterior view. Diffuse periosteal thickening along the shaft of the tibia. Section for microscopic study taken at level indicated by the arrows, and represented by Fig. 2.

cortical bone (c.b. in figures 2 and 3) averages almost a millimeter in thickness. Entirely surrounding the old cortical bone there is a layer of new subperiosteal bone formation (n. s. b. in figures 2 and 3), a little more than a millimeter thick, in which there are complete Haversian systems. The periosteal tissue (P in figures 2 and 3) is somewhat thickened.

This section presents a most striking example of new subperiosteal bone formation.

Radiograph of the left ulna is represented in figure 4, which shows marked periosteal reaction with some destruction in the lower end of the

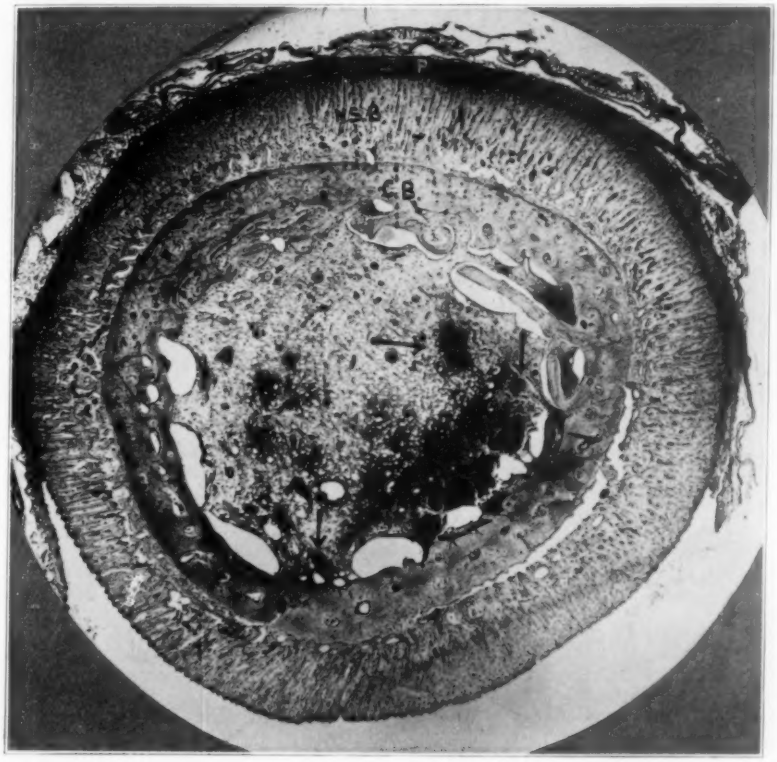

FIG. 2.

Cross section of the entire right tibia, taken at the level indicated by arrows in Fig. 1 (low power microphotograph). C. B. indicates the old cortical bone; N.S.B. the new subperiosteal bone. These structures are seen in their entire circumference. P represents periosteum. The arrows point to miliary tubercles in the marrow.

shaft. Also a slight periosteal reaction is seen along the left radius. A complete cross section of the bone is taken at the level of the arrows and is represented by figure 5. The marrow here also presents many small tubercles (see arrows in figures 5 and 6), tuberculous granulation (figure

7), and fibrosis. The formation of new subperiosteal bone is also manifest here, but less strikingly so than in the right tibia. On one edge of the section there is destruction and necrosis. This area represents that portion of the bone associated with the sinus.

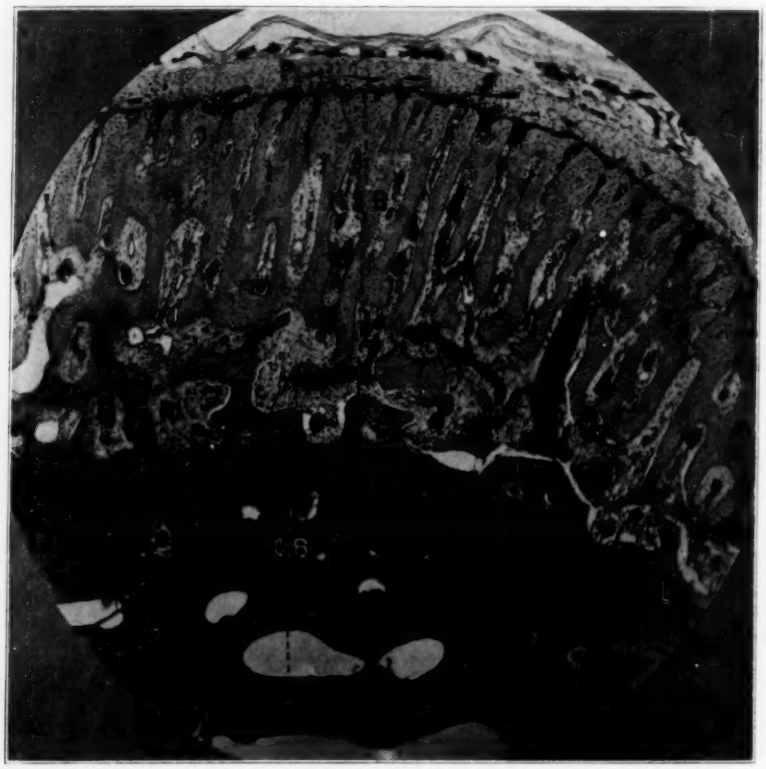

FIG. 3.

A higher power microphotograph, representing a portion of old cortical bone and new subperiosteal bone formation illustrated in Fig. 1. C. B. indicates the old cortical bone; N.S.B. the new subperiosteal bone; and P the periosteum.

Figure 8 represents a radiograph of the left fibula, showing a marked destructive process in its lower end. A complete cross section is taken at the level of the arrow, and is shown in figure 9. There is marked destruction of bone here, only a small portion of the shaft and marrow on one side being represented in an entire cross section. The

marrow present shows tuberculous granulation and fibrosis (indicated by the arrow). The old cortical bone shows necrotic changes (sequestrum formation), and here again there is formation of new subperiosteal bone. The adjacent muscle shows marked atrophy.

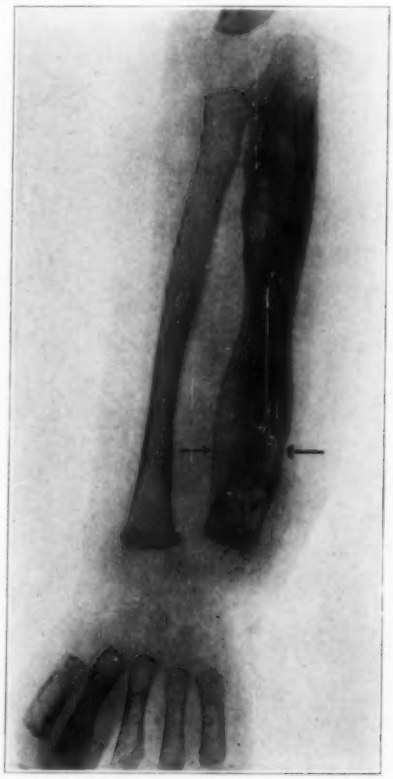

FIG. 4.

Roentgenogram of left ulna and radius. Very marked periosteal reaction with some destruction in the lower end of the shaft of the ulna. Slight periosteal reaction along the shaft of the radius. Section for microscopic study taken at the level of the arrows and represented by Fig. 5.

In all of these bone lesions the tendency to the formation of tuberculous granulation, little caseation, and the presence of comparatively few giant cells, are noticeable.

Scrapings of bone marrow from the left fibula proved to be tuberculous by guinea-pig inoculation (human bacillus by rabbit inoculation).

In view of the finding of both the destructive and formative types of lesions in this case which has been proved to be of tuberculous etiology,

FIG. 5.

Low power microphotograph of entire cross section of left ulna taken at level of arrows in Fig. 4. Many miliary tubercles (indicated by arrows), tuberculous granulation, and fibrosis. Some new subperiosteal bone formation. Destruction and sinus formation are seen on one side.

it would seem worth while to recall at this time the behavior of tuberculous lesions in bone[2]. In the first place, the histology of the tubercle, caseation, tuberculous granulation tissue formation, and fibrosis in bone is similar to that observed in tuberculous lesions in other organs. Two

types of tuberculous lesions have been recognized; namely, (1) the granulating or fungus type and (2) the caseating type. The results of these two on bone substance are different—the granulating type absorbs, and the caseating type necrotizes bone.

Purely granulating type of tuberculosis seldom occurs. Occasionally non-caseating, red granulation tissue containing few tubercles is seen extending the entire length of the bone, and is known as "caries

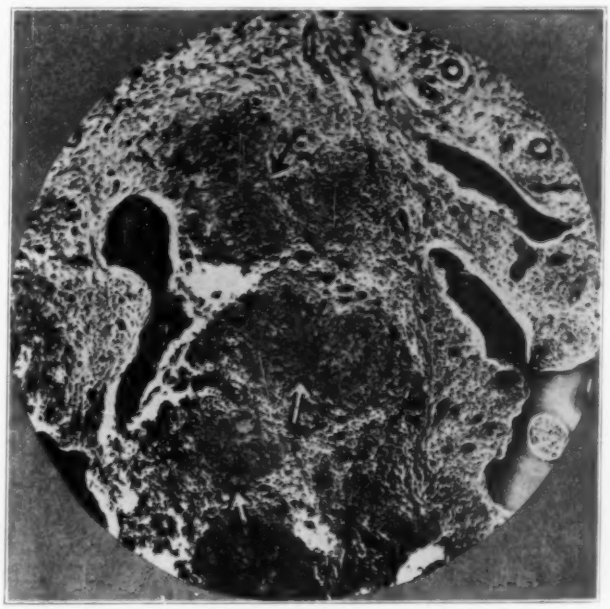

FIG. 6.

Higher power microphotograph from section of left ulna showing miliary tubercles (indicated by arrows).

carnosa," which destroys from the inside out until the cortical bone remains as a thin shell. This type is most often seen in the humerus as a sequela to shoulder joint tuberculosis.

In the caseating type, the granulation quickly becomes caseous, before it has absorbed the surrounding bone substance. The involved bone substance dies when caseation cuts off the circulation. Practically all caseating bone foci are tuberculous; however, syphilis and, less frequently, inspissated pus of pyogenic osteomyelitis may give rise to

this type of lesion. At the periphery of the lesion the process advances by formation of tubercles and granulation tissue. The caseated sequestrum lies in a cavity lined with tuberculous granulation and from this further sequestrum formation takes place. Therefore, healing does not occur; the bone is rarefied through the invasion of granulation tissue.

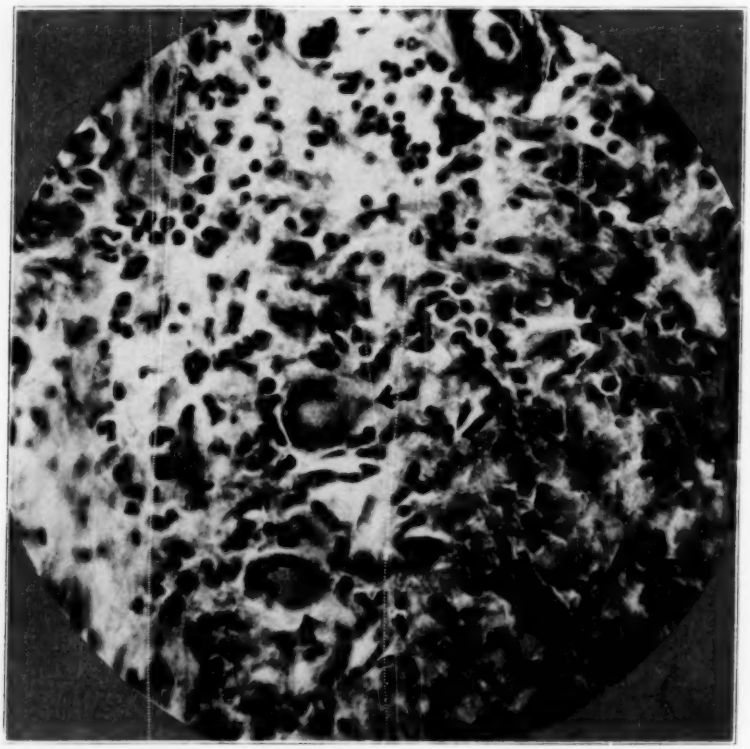

FIG. 7.

Higher power microphotograph from section of left ulna showing tuberculous granulation tissue. Giant cells indicated by arrows.

This process is chronic in nature, covering a comparatively longer time, in contradistinction to sequestrum formation of pyogenic osteomyelitis, where healthy bone is suddenly affected. A solid sequestrum is more likely to be that resulting from pyogenic osteomyelitis. Caseated material often liquefies; when this takes place localized or dissection abscess formation may result.

In the localization of tuberculous foci, there seems to be a special preference for spongy bone tissue, as, for example, vertebrae, epiphyses of long bones, short bones of the hands and feet. In spongy bone, tuberculosis is usually manifest by circumscribed foci, diffuse cellular infiltration and granulation tissue formation, and is purely destructive. The bone involved is destroyed, and in general new bone formation fails, in contradistinction to what happens in syphilitic osteitis.

FIG. 8.

Roentgenogram of left tibia, fibula, and foot (lateral view). Diffuse periosteal thickening along shaft of tibia. Destructive process in lower end of fibula (indicated by arrow). Section for microscopic study is taken at the level indicated by the arrow, and is represented by Fig. 9.

Acute miliary tuberculosis in bone marrow usually affects the cortical bone and bone trabeculae very little. However, tuberculosis in bone usually begins as osteomyelitis, and by extension to the surface of the bone a periostitis develops. Tuberculous periostitis plays an important rôle in the face bones and the ribs. Here it may more often begin in the

periosteum, or develop from a small osteomyelitic focus near the surface, and advance rapidly along the whole surface of the bone by way of the inner periosteal surface, with destruction of the tissue; and in this instance no subperiosteal bone proliferation takes place.

In the cranial bones a localized caseating osteitis (often giving a punched out radiographic appearance) is seen, with the formation of a sequestrum the whole thickness of the bone, and the periosteal surfaces are covered with tuberculous granulation. Here there is no evidence of new bone formation, which is in contradistinction to syphilis.

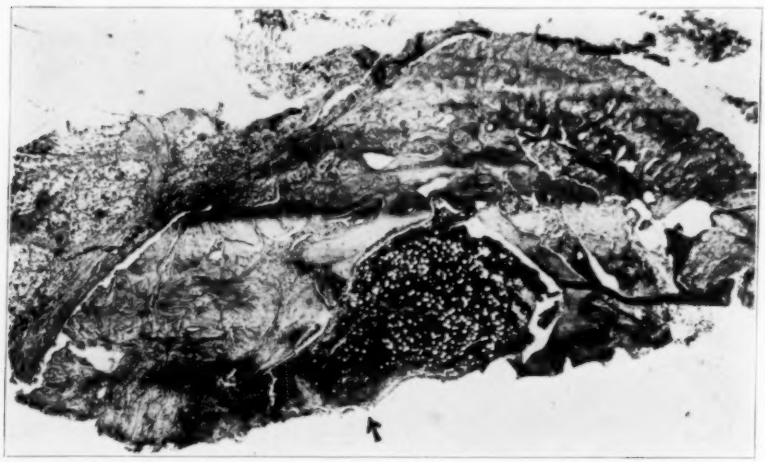

FIG. 9.

Low power microphotograph of entire cross section of left fibula taken at level of the arrow in Fig. 8. Necrotic changes in old cortical bone and formation of new subperiosteal bone are seen. Tuberculous granulation tissue and fibrosis in marrow (indicated by arrow).

In some cases tuberculous bone foci show a tendency to heal by encapsulation. A complete healing is seldom accomplished and foci may remain latent for years. There is very little tendency to new bone formation surrounding tuberculous foci. In case new bone formation does occur, it is usually seen in the joints where there is an associated arthritis, forming osteophytes in the joints.

Foci may begin as a tuberculous arteritis and wedge-shaped caseous areas form in the epiphyseal end of the bone. Sequestra may form and

remain without sinus formation for years, or the process may extend into the joint with resultant tuberculous arthritis.

Central tuberculosis of the diaphysis of long bones is seldom seen. This form is most often seen in the small long bones of the hands and feet, tuberculous dactylitis or "spina ventosa" being the commonest example. The relatively frequent occurrence of the tuberculous lesions in these long bones is explained possibly in that during the first four years of life spongy bone is present along the marrow cavities of these bones. The spindle shaped swelling takes place by new subperiosteal bone formation, while from the inside bone absorption takes place and leads to the appearance to which the description of being "blown up with air" has been applied. The distal phalanx usually escapes, the finger assuming a "bottle-like" appearance. The same type of central tuberculosis, with circular new subperiosteal bone formation, also occurs in the ulna and tibia, and represents one of the most striking lesions in the case described in this paper.

SUMMARY: This case is reported as one which illustrates the difficulty of differentiating roentgenographically between pyogenic osteomyelitis, tuberculosis, and syphilis. It furthermore offers an opportunity of correlating definite pathologic findings with an atypical radiographic appearance. Both destructive and formative types of bone lesions are present in a case proved to be tuberculosis. The case is a striking example of a predominately formative reaction in tuberculosis of bone.

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PERIRENAL ABSCESS IN CHILDREN.

BY WALTER G. ELMER, M.D., PHILADELPHIA, PA.

Beginning perirenal abscess in children is usually mistaken for tuberculosis of the hip or spine. For this reason the patients are referred to the orthopaedic clinic. The condition is by no means rare and any large orthopaedic service may have several cases admitted during the year. There should be no great difficulty, if a careful examination is made of the child, in arriving at a correct diagnosis.

The history of the case usually is that the child ceased active play and for a number of days had been limping, the thigh slightly flexed, the body inclined forward, a little fever in the later part of the day, restless and wakeful at night, and having pain which is variable and rather indefinite, especially in young children, when it cannot be definitely localized. These symptoms may indicate beginning tuberculosis of the spine or hip.

There may have been an injury from which the child recovered. If the child is developing tuberculosis of the spine or hip, the injury probably occurred anywhere from six weeks to three months previously, there was apparently complete recovery, and the injury forgotten. If, however, the patient happens to be developing a perirenal abscess which was caused by an injury, the latent period will be much shorter—probably two weeks or less. That is, the injury may have caused hemorrhage into the tissues surrounding the kidney. The blood clot, instead of remaining sterile and being gradually absorbed, is infected with pyogenic organisms and the abscess develops. Pain and local irritation cause reflex spasm of the psoas muscle, the thigh is flexed, and this causes the child to limp in walking. If the case is one of tuberculosis of the lumbar spine the psoas spasm is in most instances bilateral, and the child leans forward while standing or walking. There may, however, be unilateral psoas spasm.

A perinephritic abscess may have its origin within the kidney, but this is very exceptional. The patients usually show no kidney derangement and the urine remains normal throughout the illness.

The abscess is caused by a pyogenic infection occurring in the fat and connective tissue in which the kidney lies imbedded. The resistance of the tissues is low and the abscess may increase rapidly in size, sometimes filling half the abdominal space.

The position of the abscess in the early stage of its formation may influence the position of the child in standing and walking. It has seemed to me that the attitude assumed by the patient divides the cases into two distinct groups—those that hold the spine in hyperextension and cannot be induced to flex the spine; and those that keep the spine constantly in moderate flexion and cannot be persuaded to extend or hyperextend the spine.

The apparent explanation of this is that when the abscess lies between the kidney and the posterior abdominal wall, the erect posture does not increase the pain, whereas flexing the trunk forward brings the costal margin and pubes closer together, compressing the abdominal contents which cushion upon the kidney, and this in turn upon the abscess, causing increased pain. On the other hand, if the inflammatory mass lies above, below, or anterior to the kidney, a position of moderate flexion of the trunk relaxes the structures in which it is imbedded, while extension or hyperextension of the trunk puts these structures on the stretch and increases the pain. This is purely conjectural, however, as there are no autopsy reports available to confirm the theory.

The mortality of perinephritic abscess in children must be exceedingly small. The patients whom I have seen have recovered. A very active staphylococcus aureus infection or one caused by the streptococcus would undoubtedly result in a most serious septic condition which might terminate fatally.

In most of the cases the infection is of a mild type, the temperature range varies up to 101° F. and sometimes may reach 102° or 103°, the pulse is correspondingly rapid, the child is restless and fretful and gradually loses weight.

In the early stages, the roentgenograms do not assist us very much in making a diagnosis. It is not until the abscess reaches a considerable size that the shadow can be seen, just as is the case with the cold abscess of Pott's disease.

We must depend, therefore, almost entirely upon our physical examination. As already noted, every child who has been referred to the orthopaedic clinic in the early stage of perirenal abscess had been previously diagnosed as a case of beginning tuberculosis of the spine or hip. We first exclude the hip. The thigh cannot be brought down into complete extension while the child lies supine because of the spasm in the psoas muscle. When the leg is flexed to a right angle on the thigh and the thigh to a right angle on the trunk, we can move the hip about freely in all directions—rotation, adduction and abduction, and complete

flexion on the trunk. We thus exclude tuberculosis of the hip, for in that case all the muscles about the hip are more or less in a state of reflex spasm.

We next exclude the spine. If the case is one of early tuberculosis of the spine, all the muscles in which the spine lies imbedded are to a greater or less extent in a state of reflex spasm, and the normal range of movement in the region of the disease is absent. This applies to movements in all directions—flexion, lateral flexion, and hyperextension, as well as torsion or rotation. If the child is developing a perirenal abscess and belongs to the group mentioned above where the spine is held in hyperextension even though the body be inclined forward while standing or walking, due to the psoas spasm, we cannot induce the child while in the sitting position to flex his spine forward. By placing him prone across the bed with his thighs hanging over the edge of the bed we can seize him gently by his thighs and raise his pelvis and lower trunk off the bed; the spine sinks forward into hyperextension and by gently raising and lowering the pelvis, as well as moving it from side to side, we can readily demonstrate that the spine itself is not being held rigid in muscle spasm but possesses free movement throughout its entire length, in lateral bending as well as in hyperextension.

This eliminates tuberculosis of the spine from this group. If, however, the child belongs to the other group where the patient walks with the body inclined forward and the spine slightly flexed and the child cannot be induced to straighten or hyperextend his spine, he should be placed in the sitting posture with the knees and the thighs flexed, and usually we shall have no difficulty in persuading him to bend forward and put his head between his knees. We see the spine flexed throughout its entire length, no particular segment being held rigid in muscle spasm. Gently rotating the arms and shoulders from side to side will also demonstrate the mobility of the spine. Thus we exclude tuberculosis of the spine from this group.

Having now made a reasonably accurate diagnosis, the child should be put to bed, a leucocyte count made, a roentgenogram taken, a very light Buck's extension—not more than two pounds— put upon the flexed limb. The child should have a simple nourishing diet, chiefly milk, about a quart daily, water freely, a mild laxative such as the aromatic fluid extract of cascara sagrada, gtts. xx-xxx, night and morning, and an occasional enema if required. We must then await developments. Now and then a child will recover without the development of a definite abscess. Usually, however, the abscess will increase slowly in

size. The semi-circumference of the trunk may be a little larger on the affected side than on the normal side. The abscess begins to seek an outlet in the direction of least resistance. It may form a large retroperitoneal collection, pushing its way forward until it comes in contact with the anterior abdominal wall. It may work its way downward into the iliac fossa and point above Poupart's ligament; it may follow the psoas muscle as a guide and seek an outlet in the groin or at the anterior margin of the tensor vaginae femoris muscle; it may burrow posteriorly, perforating the lumbar fascia and appear at the outer edge of the latissimus dorsi and erector spinae muscles in the iliocostal space or in Petit's triangle. It does not seem necessary to do any operation until we know definitely where the abscess is and how to reach it without risk to the patient. I do not believe that it is wise to search for it with the exploring needle and aspirating syringe. We might easily penetrate the renal vessels or injure the aorta if we are working on the left side—or the inferior vena cava if on the right. The distance that separates these structures in a child is not great.

When the abscess points in a region where it is easily accessible we should reach it by open incision and blunt dissection. This usually means an incision in the iliocostal space. When the abscess points below Poupart's ligament it is opened at that point. After evacuating the pus, a small drainage tube should be sewed in place to remain until the discharge has nearly ceased.

The children recover rapidly after drainage of the abscess and can usually be out of bed in a few days, or as soon as the temperature remains about normal. They gain in weight, improve in color, and probably in a month or less have returned to normal health. Simple tonic treatment if the child is anemic is usually all that is required in the way of medication.

RADIUS CURVUS (MADELUNG'S WRIST).

BY B. H. MOORE, M.D., CHICAGO, ILLINOIS.

In 1878, under the title "Spontaneous Dislocation of the Hand Forward," Madelung described a deformity of the wrist which has since borne his name. The case he described was a dislocation of the carpal bones from the radius, without associated bony deformity. Duplay, in 1885, described a deformity of the wrist in which the external appearance was very similar, but in which there was an anterior curvature of the radius in addition to the subluxation of the hand. He called the deformity, "Radius Curvus."

In the literature these two types are rather indiscriminately called Madelung's wrist. In fact, they are regarded as two stages of the same deformity.

Radius curvus is rather rare, there being about seventy-five cases on record. The two cases reported here were seen at Cook County Hospital. The first was referred to my service by Dr. Paul Blaisdell. The second was on Dr. Lewin's service. He kindly permitted me to study it.

Case 1. K. McD., a 16 year old girl, came on account of the deformity of the left wrist. About two years previously she had had some trouble with the wrist which had been variously diagnosed as sprain and rheumatism. The pain had not been very severe but had been made worse by use of the hand. No other joints were affected. There was no history of any special trauma, and she was not doing any hard work. She played the piano a little, and was taking a course in typewriting. Soon after the pain began she noticed that "the hand was being drawn out of place a little." This deformity gradually increased. When it reached its maximum the pain ceased and she has had none since. This was about a year afterward.

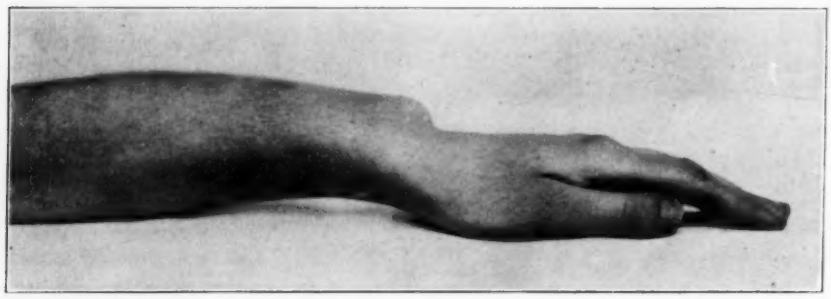

FIG. 1.
Case 1. Hand before operation.

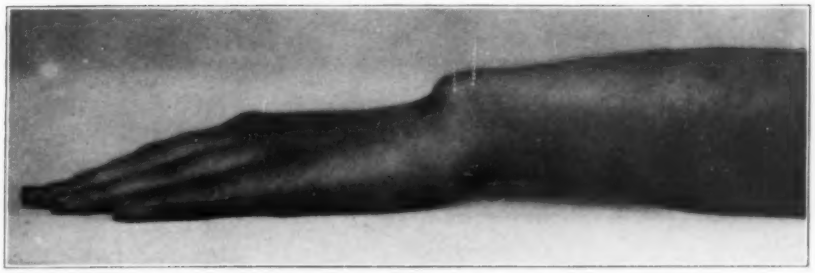

FIG. 2.
Case 1. Hand before operation.

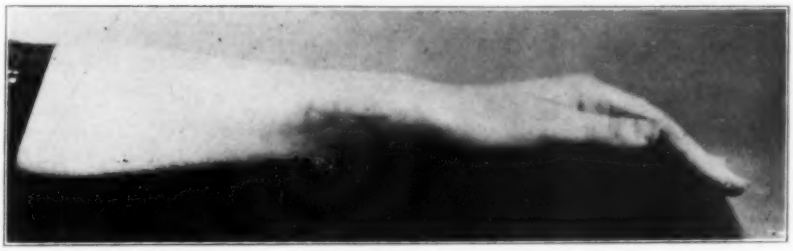

FIG. 3.
Case 1. Hand after operation.

FIG. 4.
Case 1. Hand after operation.

Examination: The left hand was displaced somewhat forward on the radius with a slight ulnar deviation. The head of the ulna was very prominent, and could not be pushed back into normal position. The lower fourth of the radius was curved forward moderately. Flexion of the wrist was unusually free but extension was rather limited. Pronation and supination were normal. No motion was painful. The patient was small in stature, but well developed. Her arms and legs were short in proportion to her body.

Roentgenograms were taken of both wrists for comparison.

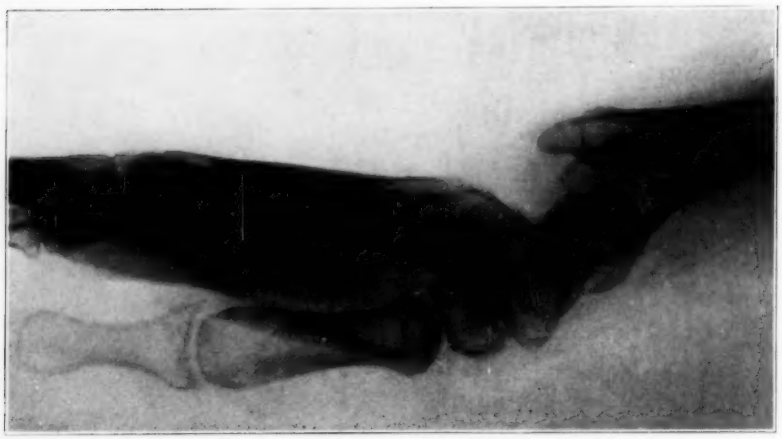

FIG. 5.
Case 1. Roentgenogram of wrist before operation showing forward curve of radius and dislocation of ulna.

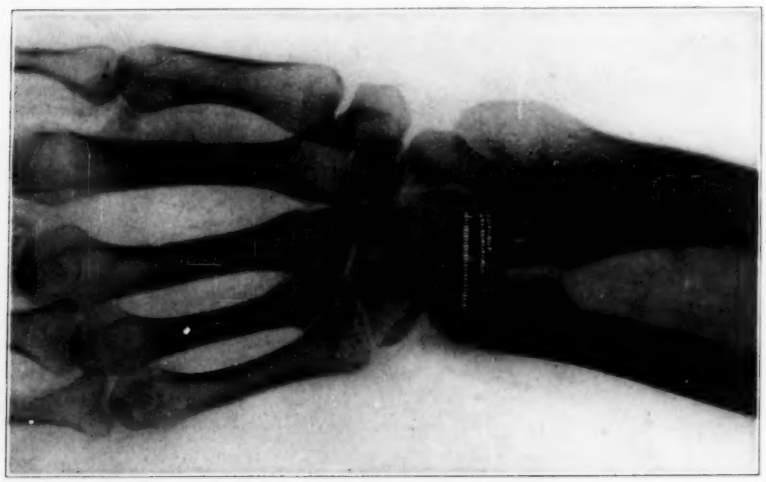

FIG. 6.
Case 1. Roentgenogram of wrist before operation showing triangular area of lessened bone density on medial side of radius.

Lateral view: The lower end of the left radius curves forward. Its articular surface looks somewhat forward. The semilunar bone is also carried somewhat forward so that its articulation with the os magnum looks forward slightly.

The head of the ulna is back of its normal relation so that the interval between it and the carpal bones is increased.

Antero-posterior view: The shaft of the radius is curved away from the ulna. This curve is gradual but is accentuated at the lower end of the radius. Its lower end overlaps the carpal bones to a greater extent than is normal. The distal end of the radius is considerably hypertrophied. The ulna is straight and its head distinctly overlaps the pisiform bone. Both the radius and the ulna are thicker than those of the normal hand. The carpal and metacarpal bones are also somewhat more dense than those of the normal hand. There is no trace of the epiphyseal line in either hand. On the ulnar side of the distal end of the radius there is a somewhat triangular area of lessened bone density with the apex directed upward. This is also seen to a lesser extent in the lateral view. Operative correction was advised and accepted. Through a short incision over the lower end of the radius a small wedge of bone was removed at the point of greatest curvature. This allowed easy correction of the deformity. The correction was retained by a plaster cast with the hand in extension. This was removed in six weeks, and massage and motion were begun. A month afterward the wrist showed normal motion. Extension was increased but some of the abnormal flexion had been lost. The deformity was corrected.

Case 2. J. S., a 15 year old boy, came to the hospital because of deformity of the left wrist. About two years previously the parents had noticed a little thickening of the wrist associated with slight pain. There was no special trauma, though the boy boxed a good deal and thought he might have hurt it. The deformity developed slowly and reached its maximum in about a year, when the pain ceased and he had had none since.

Examination showed a marked backward projection of the head of the ulna. There was some forward curve of the radius and slight ulnar deviation of the hand. Extension was moderately limited. Flexion was more free than normal. The tip of the ulna could be pressed nearly to its normal position with moderate pressure. The patient was of normal stature and development.

Roentgenogram. Lateral view: The head of the ulna is displaced backward completely away from its normal position. The ulna is also considerably longer than the radius. The radius shows a slight forward curve at its lower end. The articular surface looks slightly forward. There is a small triangular area of lessened density in the lower end of the radius. The epiphyseal line is still distinct.

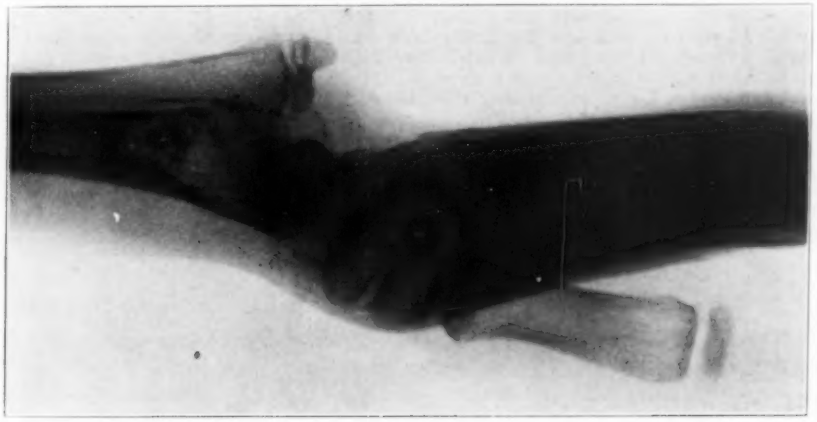

FIG. 7.
Case 2. Roentgenogram before operation showing dislocation of ulna.

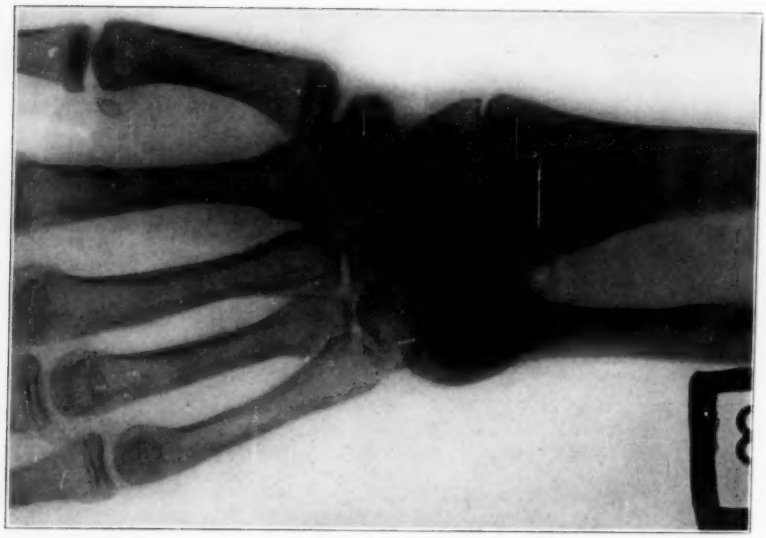

FIG. 8.

Case 2. Roentgenogram before operation showing triangular area of lessened density on medial side of radius.

Antero-posterior view: This shows the lower end of the radius slightly curved toward the ulna. The articular surface shows a marked inclination toward the median line. There is a very distinct triangular area on the ulnar side of the radius where the bone appears much less dense. The apex of this area is directed upward. The epiphysis appears to be wedge shaped, with the thin edge of the wedge at the base of the triangular area mentioned. The semilunar bone was set more deeply than in the normal wrist. Stereoscopic roentgenograms made later for the purpose of studying this peculiar appearance showed that the triangular area was really cone shaped, with the apex directed upward. There was a defect in the epiphysis at the base of the cone, so that the epiphysis was crescentic and surrounded about half of the cone. The operation performed by Dr. Lewin consisted of resection of the head of the ulna and suturing the extremity of the ulna to the carpal bones. The result was good.

In the literature on this subject we find a variety of cases described. Abadie in 1903 and Gasne in 1906 give the most complete reviews of the subject.

The histories of the cases show a remarkable similarity. The age at onset is practically always 12 to 14 years. Madelung saw two cases which developed after 20 years of age. The onset is with pain in the affected wrist. It may be preceded by trauma, either accidental or occupational. The deformity appears later as a slowly developing forward displacement of the hand.

The physical findings in the cases reported show a marked variation. According to the physical findings, the cases can be divided into four classes.

1st. Those showing simply hypertrophy of the distal end of the radius and ulna.

2nd. Simple subluxation of the wrist with lax ligaments, which is easily reduced.

3d. Subluxation of the wrist with changes in the articular surface of the radius and dislocation of the head of the ulna. This is difficult of reduction.

4th. Curvature of the radius with associated dislocation of the head of the ulna and changes in the carpal bones. This type cannot be reduced.

These four types cover the cases reported in the literature as Madelung's deformity. It is difficult to see how cases of the first class can be considered as definite instances of the deformity, yet about one-third of the reported cases fall into this class. The other three classes may be considered as representing the evolution of the deformity.

As to the cause, practically every structure in the wrist has been blamed for the deformity. Madelung considered that the primary cause was weakness of the carpal ligaments, allowing the flexor tendons to drag the hand forward. Dupuytren and Weber and Busch believe it due primarily to a contracture of the flexor muscles. Felix considers that there is a state of hyperexcitability of the spinal cord producing a reflex contraction of the flexor tendons. This is entirely hypothetical, however.

With regard to the bony changes found, there have been many different opinions. Nélatíon suggested an old fracture, with displacement of the fragment. Duplay considered the cases with curved radius as a manifestation of late rickets. Madelung, Volkmann, and others have considered the changes which occur in the articular surface of the radius as due to abnormal pressure causing a distortion analogous to that of genu valgum. Gangolphe and Redard believe that the deformity is produced by faulty growth in the epiphyseal cartilage produced by trauma or disease.

With all this wealth of theory there are still some facts that remain difficult to explain. Most of the theories lay stress on the rôle of trauma, either accidental or occupational, as a contributing cause, and it is true there is often a history of more or less definite trauma. Yet the great majority of cases occur in females, who are certainly not more subject to

trauma than males. Furthermore, trauma does not explain the remarkable uniformity of the age at onset, nor the rarity of the cases.

The theory of Gangolphe and Redard that faulty growth of the epiphysis is a factor, seems to receive support in the two cases here reported. The area of lessened bone density at the lower end of the radius is very noticeable. This finding is not mentioned in the literature, although in looking up the history of a case at the Massachusetts General Hospital, through the courtesy of Dr. Osgood, the same thing was noted in the x-ray report.

It suggests very strongly a cessation of growth in that portion of the epiphyseal line. As the bone grows in length and also in diameter, the cone shaped area of less dense bone would be formed. The more rapid growth of the unaffected portion would produce distortion of the radius, and the ulna growing more rapidly would necessarily push the hand forward or itself backward.

In the second case, in which the epiphysis is not yet united, the defect in the epiphysis is very evident in the stereoscopic reontgenogram. What the factor is which causes so sharply localized injury to the epiphyseal line, is difficult to explain. A very low grade bacterial infection might produce the localized injury. At any rate, the deformity appears to be one of those affecting the epiphysis of growing bone which places it in the class with Legg's "flat head" deformity of the femur.

HABITUAL DISLOCATION OF THE PATELLA.*

BY W. E. GALLIE, M.D., AND A. B. LEMESURIER, M.D., TORONTO, CANADA.

"Habitual dislocation of the patella" is the name given to a condition in which, for one reason or another, the patella is so insecurely held in the intercondylar groove that during ordinary movements of the knee-joint it frequently slips over the lateral condyle. It produces great disability as the dislocation is always accompanied by acute pain and is usually followed by more or less synovitis.

Like habitual dislocation of the shoulder it may develop as a sequel to violent traumatic dislocation. When the patella becomes thus dislocated in a previously normal knee, either as a result of direct violence or unusual muscular action, there is a definite rupture of the capsule and synovial membrane on its inner side. If this rupture is extensive the subsequent distention of the joint with blood will prevent, in many cases, the spontaneous apposition of the edges of the rent, with the result that, when the process of repair is complete, the inner portion of the capsule is relaxed and less able to hold the patella in its groove. As a consequence the dislocation frequently recurs, and each time as a result of a lessened degree of violence, until finally it is likely to take place with the slightest misstep.

Another type of habitual dislocation is that which appears in childhood or adolescence without any obvious causative traumatism. As a rule it is present in both knees and it appears to be due to an abnormal laxity of the capsule. In some cases it is possible to push the patella over the lateral condyle of the femur with the pressure of the fingers without any great discomfort to the patient. It is a most disabling condition, however, as it always causes unexpected and sometimes dangerous falls.

Occasionally one finds patients suffering from habitual dislocation who have anatomical peculiarities about the knee which predispose to the displacement. Thus a marked degree of knock-knee undoubtedly increases the tendency to a lateral slip of the patella. In other patients the lateral half of the inter-condylar notch is unusually low. If such a patient has also a knock-knee deformity the stage is well set for a dislocation. In our experience, however, these anatomic abnormalities have

*Read at the meeting of the American Orthopedic Association, held in Rochester, N.Y., June 7th-9th, 1923.

not been a factor, and in the majority of cases there has been nothing in the appearance of the knee, except the laxity of the ligaments, to suggest any cause for the dislocation.

Treatment of habitual dislocation of the patella by knee cages, elastic stockings and trusses of various forms in usually quite ineffective. Most surgeons appear to be agreed that some form of operative interference is necessary. The great variety of operations suggested, however, shows at once that the results are not all that could be desired.

One of the earliest methods employed was the longitudinal plication of the inner portion of the capsule, with or without the excision of an elliptical portion. This is a very ineffective operation as it seldom prevents recurrence for more than a few months. We have shown in a previous paper[1] that fibrous structures such as the capsule of the knee heal together, when sutured, by a loose areolar scar which readily stretches under strain and allows the folds to return to their former position. Plication of the capsules of joints, therefore, in the hope of increasing their strength, is an operation which should not be performed.

Impressed by the association of the knock-knee with habitual dislocation of the patella some surgeons have advocated improving the line of pull on the patella by correction of the knock-knee deformity or by transplanting the tubercle of the tibia inward. If supracondylar osteotomy is performed it will be necessary to give the patient a considerable degree of bowleg before there is any assurance of improvement, and in such an operation the disadvantages are obvious. The inward transplantation of the tubercle of the tibia may be criticized on the grounds that it is uncertain in accomplishing a cure and that it may lead to lessened power in the extension of the knee. We have done one of each of these operations and were not impressed with either of them.

Tubby[2] believes that the tendency to dislocation is the result of a laxity of the quadriceps extensor. He recommends reefing the muscle by sutures. For reasons already given we do not believe that muscles can be permanently tightened by any method of suture, nor do we see how a successful reefing could lessen the tendency to dislocation.

Based on the idea that the chief predisposing cause of the dislocation is the imperfect development of the lateral condyle, several operations have been recommended. Glaser[3] does a supra-condylar osteotomy and rotates the lower fragment inward, thus bringing the external condyle forward. Murphy[4] suggested deepening the intercondylar groove with a gouge and lining the raw surface of the bone with a pad of fat and fascia turned down from above. Albee[5] divides the external condyle and

pries it forward so that the outer wall of the notch is elevated. The fragment is maintained in this position by a wedge of bone transplanted from the tibia and driven into the cut. None of these operations has appealed to us, partly because of their uncertainty and partly because of the mutilation and consequent dangers which they entail.

Another group of operations has been described, designed to tether the patella in place, rather than to change the position of the bones. For instance, Krogius[6] dissects up a longitudinal bridge from the inner side of the capsule, and, leaving its ends attached, transplants its central portion across in front of the patella into an incision through the capsule on the outer side. Whitelocke[7] recommends the transplantation of the tendon of the gracilis, and Robertson[8], of the tendon of the semitendinosus, into the upper part of the patellar ligament. Goldthwait splits the patellar tendon longitudinally, detaches the outer half from its insertion into the tibia, transplants it behind the inner half to the inner side of the head of the tibia, and there fixes it by sutures to the periosteum and insertion of the sartorius. Owing to the insecurity of the fixation obtained by suturing any tendon in this manner to the periosteum, this operation has been improved by transplanting, with the outer half of the tendon, the portion of bone into which it is inserted.

The procedures outlined either require extensive dissection, as in the operation of Krogius, or possess the mechanical fault of anchoring, not the patella, but the patellar tendon, and thus fail to prevent the dislocation. Moreover, the pull exerted by the anchoring structure is oblique, and not in a direction opposite to the line of the displacement. How successful these operations are, we do not know as we have never tried them or seen cases which had been operated upon. We have heard Goldthwait's operation highly recommended, however, and have no doubt that for mild cases it is a valuable method. It has the advantage that it is a simple operation which can be performed with comparatively little danger to the patient. For severe cases, however, we would hesitate to trust it.

The operation we employ is based on the same principle of anchoring the patella in place regardless of the original cause of the dislocation or of any anatomical peculiarities that may be present. It consists, briefly in tethering the patella itself, by a strand of tendon or fascia, to the internal condyle of the femur at the point which forms the centre of the circle through the arc of which the patella moves on flexion and extension of the knee. As we have shown experimentally, in common with other observers, transplants of tendon, when not too thick, and transplants of

fascia, live indefinitely and retain their characteristic structure and strength[10]. It is only necessary, therefore, to make certain of solid union of the tendon or fascia to both the patella and the condyle to obtain the desired result. This solid union can be obtained, as we have shown, by carefully clearing the transplant of all areolar coverings and then placing it in intimate contact with denuded bone over a sufficiently large area[11].

The technique of the operation varies with the force that is required to hold the patella in place. Occasionally, as in the case which we reported to this Association four years ago, the force necessary is very great and in such conditions we use a thick piece of the tendo Achillis. A review of this case will indicate the type of patient to which the method is applicable and the various steps of the operation.

In the autumn of 1917 a soldier was admitted to our wards with a dislocated patella which had been lying on the lateral aspect of the outer condyle for several months. He was unable to walk and he suffered great pain when any attempt was made to move the joint. His story was that a year previously he had been buried in sandbags and had sustained among other injuries a dislocation of the patella. The dislocation was reduced and the limb placed at rest in full extension in splints. The attending pain, swelling, and ecchymosis make it seem likely that a large rent had been produced in the capsule and synovial membrane medial to the patella. Soon after he began to walk again the displacement recurred following some unusual exertion. He was sent into hospital and a plication of the medial portion of the capsule performed. Three months later the dislocation occurred again as a result of a slight misstep, and although it was reduced it recurred immediately. After some further desultory attempts at treatment the patella was allowed to remain on the lateral aspect of the joint. Examination showed that in addition to the displacement of the patella the joint was abnormal in that there was a decided degree of knock-knee.

The operation consisted first of an exposure of the patella and a dissection of the adhesions so that the dislocation could be reduced. The patella was forced back into the intercondylar groove with difficulty and unless held there firmly with a sharp toothed retractor immediately sprang back to the outer side of the joint. A transverse hole, about ¼ inch in diameter, was then drilled through the patella, and two other holes were drilled in the internal condyle, about 1 inch apart, and so directed that they met at a depth of about half an inch in the bone, (Fig. 1). The tendo Achillis of the same side was then exposed and a segment composed of half its thickness and about 6 inches long removed.

Its surfaces were thoroughly scarified and it was drawn through the holes in the patella and internal condyle, which it fitted tightly. The tendon was securely anchored to the patella and condyle with kangaroo tendon sutures and the wound closed. A plaster bandage was finally applied which was moulded against the outer side of the patella to prevent dislocation in case the sutures absorbed before healing was complete.

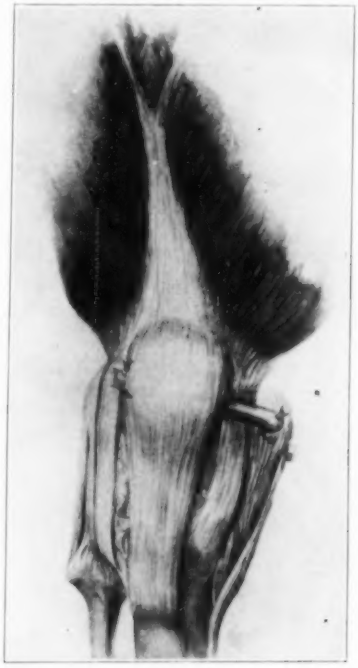

FIG. 1.
Diagram showing fixation of patella by graft from tendo Achillis, passing through tunnels in the patella and internal condyle.

It is now over six years since the operation was performed and except for a period of two months after the removal of the plaster, during which time he received massage and remedial exercises, the patient has been working steadily at his trade as a motor mechanic. He has no disability whatever and the patella is in normal position. The new ligament can be seen and felt standing out like a whip cord between the patella and the internal condyle.

For the ordinary type of habitual dislocation of the patella, however, the employment of such a strong material as the tendo Achillis is unnecessary. In these cases the tendency to dislocation can be prevented by a very moderate amount of force if it is applied in the right direction. We have accordingly substituted fascia lata for the tendon.

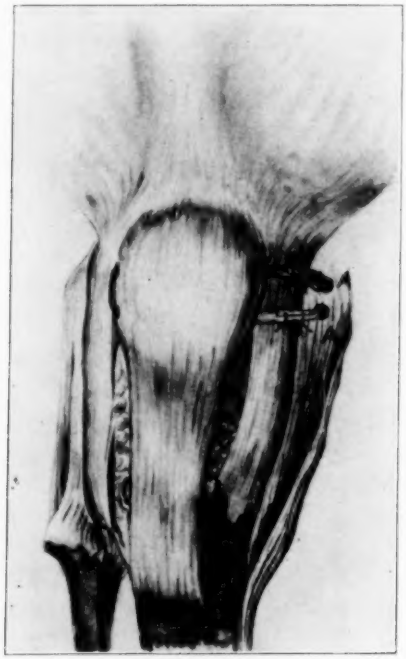

FIG. 2.
Diagram showing fixation of patella by fascial transplant. The strip of fascia is in the form of a closed loop passing through tunnels in the patella and internal condyle, with its ends overlapping widely at (*a*).

The tethering of the patella is accomplished through three small incisions, one on each side of the patella and one over the most prominent point of the internal condyle, (Fig. 2). Two transverse holes are drilled through the patella about half an inch apart and two slightly larger holes are bored in the internal condyle as in the operation already described. A strip of fascia lata, ten inches long and half an inch wide is then obtained

through an incision on the outer side of the thigh and thoroughly scraped free of areolar tissue. A stout ligature is tied to each end to facilitate insertion. This strip is then passed through the holes in the patella so as to leave a loop at the outer side of the bone. The free ends are then drawn through a subcutaneous tunnel to the incision over the internal condyle. Here they are passed in opposite directions through the hole in the internal condyle so that they overlap each other both in the tunnel in the bone and an inch or more beyond it. The fascia is then drawn taut and the loop is completed by careful suturing with chromicized catgut. By this means the patella is tethered to the internal condyle by a loop of fascia which not only heals to itself in the portion which is overlapped but also to the bones through which it passes. In a few weeks the union is so solid that all possibility of a recurrence of the dislocation is removed.

The operation has been performed in all seven times. Two patients were operated upon in 1918, two in 1919, one in 1920, one in 1921, and one in 1923. All have perfect functional results and in no case has there been a recurrence.

The advantages which we see in the operation are several. In the first place it is simple, as the only incision of any size is that through which the strip of fascia is obtained. The gap left in the fascia lata is sutured and invariably heals without leaving symptoms or disability. There is none of the risk which attends osteotomy of the femur or any operation which necessitates the opening of the knee-joint. The fixation is mechanically sound as it is obtained by means of a band of very strong material which we know will remain permanently in place and retain its strength and form, and which is so placed that it will exert the necessary pull on the patella in the right direction in all positions of the joint. Finally, the operation is applicable to all cases of recurrent dislocation of the patella and can be relied upon to prevent outward displacement, no matter what the predisposing cause.

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DISCUSSION ON PAPER OF DR. GALLIE.

DR. EDWIN W. RYERSON, Chicago, Ill.: I have operated on five cases of recurring lateral dislocation of the patella. The first two were by the Goldthwait method mentioned by Dr. Gallie and both were successful and have remained entirely satisfactory for nearly eight years. For some reason, I do not know why, when the next two cases came along, perhaps influenced by the success of Dr. Parker, in a similar case, I transplanted the patellar tendon to the outer side of the head of the tibia. Both of those cases were entirely successful. Two or three years have now passed and the patients have not observed any further dislocation. One of them came in the other day with the opposite knee beginning to feel weak. One of the interesting points is that these symptoms came on gradually. I have never seen an habitual dislocation come on after traumatism. MacAusland had a recent article on the subject in Surgery, Gynecology and Obstetrics.

Looking at Dr. Gallie's pictures and thinking over his very ingenious operation, it might be possible to split off a piece of the inner half of the tendon, turn it around and fasten it into the internal half of the femur. At first I did not think the fascia lata would be strong enough, but Dr. Gallie has shown that it is sufficiently strong. His operation is very satisfactory and I am going to try it on the next case.

DR. FRED H. ALBEE, New York City: I have done a considerable number of cases of recurring lateral dislocation of the patella, during the past ten years. Generally speaking, in many of these cases other operations had been previously done without relief of the condition. I have transplanted bone where indicated. As far as I know none of these cases has recurred. I think Dr. Gallie's operation has many advantages and should give results. The fact that we can transplant fascia and that it will remain permanently, is certainly a great step in plastic surgery of this kind. Of course it helps in many other types of operation other than this.

DR. C. L. STARR, Toronto, Ont., Canada: Just to confirm the statement of Dr. Gallie as regards the ease with which this operation can be done and the safety and permanency of the result, I want to say that one lady of whom he speaks has a most excellent result. She was for many years very much distressed with this knee, so that she gave up all social functions, even to walking on the street. Now she is back at social functions and is skipping around as any young woman would. The band of fascia is quite strong and you cannot push the patella laterally.

REPORT OF A CASE OF CONGENITAL DEFECT OF PECTORAL MUSCLES.

BY C. B. BENNETT, M. D., BERKELEY, CALIF.

From Out-Patient Department, The Children's Hospital, Boston.

Congenital defects of the pectoral muscles are not very often seen, though more or less discussed in most text-books. The condition usually causes no disability or other symptoms and is frequently first discovered by a physician in the course of routine examinations. It usually affects the lower portion of the muscle rather than the clavicular, although the

FIG. 1.

entire group of pectoral muscles may be wanting on one side. It constitutes about half of all the congenital absences found occurring in single muscle groups[1]. Only in one instance was the defect bilateral, and in the great majority of cases no definite hereditary influence can be shown. Morley[2] believes, however, that they are more apt to appear in families in which other congenital anomalies are present. There have been

approximately 230 cases recorded in literature, but extremely few from the United States.

Recently our knowledge of this subject and its bibliography has been summarized by E. B. Morley[2] in a very interesting article in the Lancet, in which he presented eight new cases. The reader is referred to this article for a fuller discussion of the subject. Among the theories for the possible origin of this deformity, that advanced by Lewis[3] was favored. This, in brief, states that the primitive pectoral premuscle mass is at one stage of development at the level of the first rib, but in the course of development migrates downward (caudad), and that these cases of congenital defect may represent simply the result of imperfect

FIG. 2

migration of the premuscle mass during early embryonic life, hence the greater frequency of the defect in the lower portion of the muscle.

This theory might explain the abnormality in the anterior axillary fold; but the abnormality is frequently not so confined as Clark pointed out. "An analysis of the literature seems to show that congenital deformity of the pectoral group does occur most frequently in conjunction with more or less extensive malformations of neighboring structures."

The following is a brief history of the case presented here.

Charles A. school-boy, age 10 years, 8 months. Born in Dorchester, Mass., of Bohemian parents. Father, mother, two brothers, and three sisters living and well. None dead. Normal delivery at full term; breast fed for one year. Boy was brought into the Out-Patient Department on August 2, 1923, by his mother, who had recently noticed some asymmetry of the pectoral region. No abnormal symptoms of any kind were present, and there was no history of any injury.

Physical Examination. In every way a normal boy of 10 years, except for his pectoral deformity. Only that portion of his right pectoralis major was present which originated from the level of the second rib and above. The pectoralis minor on that side was entirely absent, and the 3rd, 4th and 5th ribs were directly under the skin and subcutaneous tissues. Although only this small portion of the right pectoral muscle was present, it was markedly hypertrophied, so that the pectoralis action on the right side seemed as strong, if not stronger than, on the other side. The boy was right handed and showed the usual tendency to use the right arm more than the left. No scars, areas of tenderness or spasmodic muscular contractions were present, and the movements of the shoulder were normal in every way. The nipples on the two sides were normal, and symmetrically placed.

Upon fully abducting and elevating the right arm until it was pointing directly upward, there were brought out two apparently fibrous cords in the right axilla, one at the lower edge of the anterior axillary fold, which is usually present in these conditions as noticed by other observers, and a second similar cord on the anterior edge of the posterior axillary fold as shown in the accompanying illustration. Probably this second cord represented an undeveloped condition of some muscle of the posterior axillary group.

Obviously no treatment is required. It is interesting to note in this connection that, to quote Clark,[1] "Burke's patient (absence of sterno-costal portion of pectoralis major and all of pectoralis minor on the left side) was a good base ball pitcher (left handed)—and Stintzing's patient (defect left) fenced left handed."

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THE IMPORTANCE OF THE AFTER-CARE IN THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP

Z. B. ADAMS, M.D., BOSTON, MASS.

Much has been said about the method of reduction, and but little about the after-care, in congenitally dislocated hips.

Whether the hip is reduced by open operation or by one of the closed methods, it is of equal importance that the hip be kept firmly in place in the socket, and not allowed to slip out. The hip having been replaced, it should be held securely in an abducted and flexed position, so that the head is plunged as deeply as possible into the socket. It is my belief that there is no better appliance for maintaining this position than a plaster of Paris spica. This spica should surround the hips and ascend to include the lower ribs, and be well-moulded over the crests on the sides to steady the pelvis. It should also extend to the ankle, capping the flexed knee. Thus it checks rotation of the thigh, and by capping the knee, all growth in the length of the femur tends to push the head into the socket,—thus shaping the head to the socket and making the position more secure. I do not believe there is any type of splint which so well fulfills all requirements as the plaster of Paris spica.

The plaster should not be changed during the six months of holding. Thus the capsular ligaments will be allowed to shorten and stiffen. The only variations from this rule should be if the child grows so rapidly that the head of the femur is being pushed forward out of the socket by the rapid growth. Frequent changes of plaster, with or without a change of position, I believe unnecessary and dangerous. This gives a chance for the head to slip out, and removes the hold on the knee, where growth is taking place.

The position for the holding should be ninety degrees of abduction and ninety degrees of flexion. In some cases, where the hip is unstable because the roof of the acetabulum has not developed, the head may be held more securely in the socket by increasing the flexion to one hundred and ten degrees. (Wernsdorff's position.)

As far as the inwardly rotated position goes, with a femoral neck which has a marked anterior torsion—forty-five degrees or more—the head will go deep into the socket only when the thigh is inwardly rotated. This torsion will not disappear, no matter in what position you

hold the hip. When these hips are brought into a position for walking, the back of the upper neck impinges on the posterior edge of the socket, and the head is levered out, or becomes marginal. To succeed with such a hip, it is imperative that an osteotomy be done somewhere between the knee and the head. I believe it is best done just below the trochanter, rotating the upper segment inward and the lower segment outward the exact number of degrees necessary to produce a normal relation of neck to shaft.

At the end of six months the plaster is bivalved into an anterior and a posterior shell, and the exercises to develop motion and muscle strength are started. For the first three weeks the child lies in the posterior shell, the anterior shell being thrown away. Then, when the muscles are a little stronger, the posterior shell is taken away, and the child lies on a firm flat pad on a table,—not on a mattress that sags.

The first exercises are to straighten the knee. No passive exercise or stretching, simply active effort on the part of the child to straighten the knee, with the thigh in ninety degrees of flexion and ninety degrees of abduction. This makes the hamstrings tense, and they lift the hip forward and press the head into the socket. The next muscle of importance to be mobilized is the glutaeus maximus. The child is turned to lie in the ventral position, with the thigh still flexed and abducted—no attempt being made as yet to change from the ninety degrees of flexion and abduction, and the child is made to tighten the glutaeus maximus, and to make an effort to lift the thigh from the table. It is felt that the glutaeus maximus is one of the most important, if not the most important, of the muscles holding the hip in the socket, and it is often smaller than the muscle of the other side, in unilateral cases.

Exercises are also given to develop the rotators, while the thigh is still in the flexed and abducted position. When the extension of the knee is normal or nearly normal, the child is allowed to sit up, with the leg stretched out at the side, ninety degrees of flexion and ninety degrees of abduction, and while thus seated, the exercises are given to develop rotation,—the child rolling the leg in and out.

Usually about three weeks after the plaster is split, the exercises have developed the muscles sufficiently to allow the child to be lifted from the table and put into the salt bath. These salt baths are given in a tank large enough to allow space for the child to kick its legs freely. The solution is in the proportion of one kilo of salt to ten litres of water, and for the older children, one and one-half kilos of salt to the same amount of water. This makes a buoyant solution and the kicking

motion extends the legs. The child exercises in the bath for from ten to thirty minutes each day, the temperature of the bath being about seventy degrees Fahrenheit.

Each day local heat is applied over the knee and hip for a period of one hour. This can be very well done by hot sand in a double bag,—the outer bag of Canton flannel, with the nap turned out, the inner bag of strong cloth. The sand is heated in a shallow tin pan, being stirred until evenly heated throughout, to a temperature as hot as can be borne by the hand, and it is then put into the bags. These bags are of such size that they reach across the front of the joint and down on the sides. They are evenly filled and yet not packed tight, and are laid across the front of the joint and left in place for one hour. This hour of baking can be done just before the exercises are given. A half-hour should be devoted to exercises. The child should not be allowed to bring the knee forward or get the leg down before the glutei are strong.

One other thing of distinct importance in the treatment of congenital dislocation of the hip is the use of heliotherapy. When the cast has been taken off and the exercises are going on, the child should be given heliotherapy. This heliotherapy should be general and should, of course, be begun by exposing only a small portion of the body to sunlight, each day increasing the area exposed and the time of exposure, until the whole body is tanned. The heliotherapy should be continued until the child is walking. Just what effect the heliotherapy produces, I do not think anyone knows, but it seems, in rickets or tuberculosis of the bones, to harden the bones, and when the hip is being shaped in congenital dislocation, this hardening process should be employed before weight-bearing is commenced.

In closing, I simply want to reiterate that it is of exactly as great importance that the hip be held in, and a good functional hip developed, as that the hip be reduced, for if the hip is only reduced and then allowed to slip out, the child might as well have had no treatment.

CONGENITAL ABSENCE OF THE RADIUS.

With Review of Literature and Report of Three Cases.*

BY KATSUJI KATO, PH.D., M.D., LOS ANGELES.

From the Orthopaedic Service of the Children's Memorial Hospital, Chicago.

ANALYSIS

I. Introductory: Incidence of Radial Deformity.

II. Report of Cases:
  1. Case of J. P., Children's Memorial Hospital, Chicago.
  2. Case of F. K., Children's Memorial Hospital, Chicago.
  3. Case of B. S., Children's Memorial Hospital, Chicago.

III. Review of Literature:
  1. First Authentic Report by Petit in 1733.
  2. Reference by Paré in his Treatise on Monstrosities (1573).
  3. Tabulation of 250 cases reported in the literature fom 1733 to 1923 inclusive.

IV. Discussion:
  1. Principal and Associated Pathology:
    (a) Summary in table forms of the 253 cases.
    (b) Osteology.
    (c) Myology.
    (d) Angiology.
    (e) Neurology.
    (f) Associated findings.
  2. Etiologic Considerations:
    (a) Archipterygeal theory of Gegenbaur.
    (b) Amniotic compression theory of Dareste.
    (c) Nervous influence theory (Broco, etc.).
    (d) Virchow's inflammatory theory.
    (e) Maternal and fetal diseases as causes.
    (f) Familial and hereditary influences.
    (g) Theory of muscle retraction.
    (h) Theory of insufficient ossification.
  3. Author's theory of embryonic cellular dystrophy.

V. Diagnosis and Prognosis.

*Read at the meeting of the Chicago Pediatric Society, December 18, 1923.

VI. Proposed Methods of Treatment:
  1. Non-operative measures.
  2. Operative methods:
    (a) Tenotomy of contracted muscles.
    (b) Arthrodesis of ulno-carpal joint.
    (c) Simple osteotomy of the ulna (Hoffa).
    (d) Cuneiform osteotomy of Romano.
    (e) Sayre's method.
    (f) Bardenheuer's splitting method.
    (g) The method of McCurdy.
    (h) Antonelli's separation method.
    (i) Albee's tibial graft method.
    (j) Ryerson method of ulnar graft.

VII. Summary and Conclusions.

Congenital absence of the radius was once thought to be a rare condition. In his statistical report of 1444 cases of deformities treated at the Würzburg Clinic, Hoffa[1] mentions only one case of congenital club-hand and this is merely suggestive of being due to this condition. Bernacchi[2] in 1892 said that among 1851 cases of intra-uterine malformations, only two out of four cases of congenital club-hand were due to the radial defect. Tubby[3] says, however, that eleven cases were seen by him in eighteen years, and he quotes Reeves as stating that at the Royal Orthopaedic Hospital in London about three cases are seen annually. According to Antonelli[4], there were 114 cases on record up to the year of his writing (1904), although his data are both incomplete and inaccurate. At the Children's Memorial Hospital in Chicago, there are three cases on record which will be reported in this paper, although the data on one of these are incomplete, as the patient had never returned to the clinic.

REPORT OF CASES.

Case 1. J. P.; male; Italian; born September 16, 1918; was first seen in the Out-Patient Department of the Children's Memorial Hospital on the second day after birth. There is nothing of significance in the family history of the patient. Both father and mother were well. There were three older children, none of whom had any deformities. There is no history of miscarriage or of tuberculosis in the family. The child was breast-fed and has since had only occasional colds.

The examination on the first visit showed that the left thumb was absent completely, while the right thumb was attached to the hand by means of a thread-like tissue about half an inch long. Both forearms were very short and curved towards the radial side. Both feet were clubbed. The Wassermann test was negative. On November 4, 1918, the right thumb fell off spontaneously, when the patient was brought to the dispensary for the second time. At this time a more careful examination revealed the

fact that the face was of peculiar shape and the neck was very short. The pelvis was deformed and the motion at the hip joints was limited. The legs were short and there was a contracture of the muscles, causing the flexion of the legs at the knee joints. The radiographic examination made at this time (Fig. 1) confirmed the diagnosis of bilateral congenital absence of the radius. The patient was admitted to the Hospital on February 3, 1920, for tenotomy of the toe flexor tendons and of the Achilles tendon, but pneumonia developed and the child died on February 6, 1920.

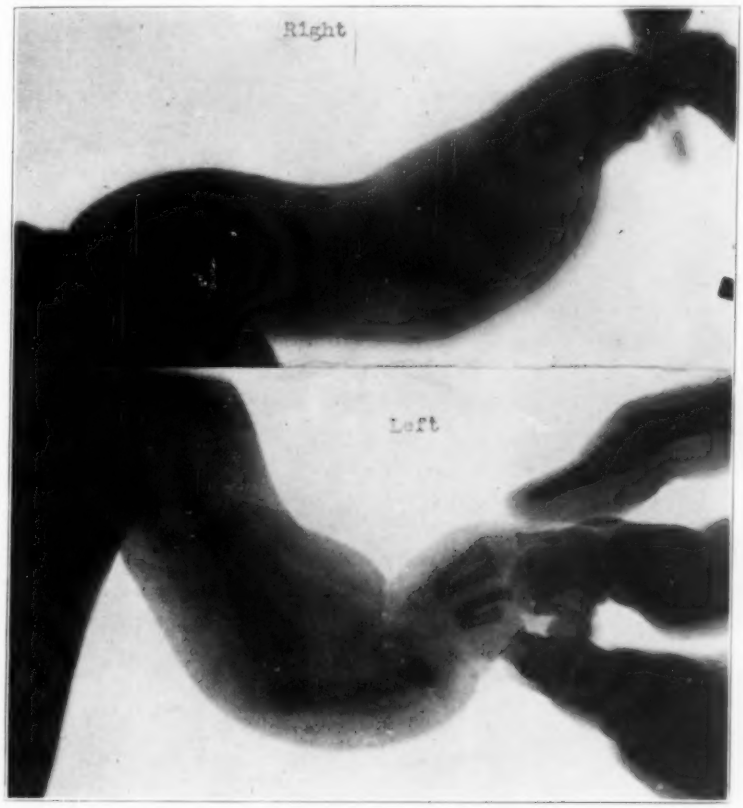

FIG. 1.

Radiographs of right and left arms (Case 1), showing bilateral congenital absence of the radius, absence of the thumb with its metacarpal bone on the left and the synostosis of the bases of the metacarpal IV and V.

Case 2. F. K.; female; American; (Fig. 2) born July 19, 1917; was first seen in the dispensary of the Children's Memorial Hospital on September 4, 1917. The patient was a full-term baby, normal delivery, breast-fed for 14 months, walked at ten months, and talked at two years. The deformity of the right hand was noticed at birth. The child had measles at one year of age, chicken pox at the age of two years, and mumps

soon afterward. The parents were both well, and five other children were well and free from any defects. One premature baby was born, but died on the 17th day. The

FIG. 2.
Photograph of F. K. (Case 2), taken on February 14, 1923, just before the operation, showing the radio-palmar club-hand on the right side, while the left is normal.

mother gave no history of miscarriage or of still-birth, and there was no history of tuberculosis in the family.

The examination of the patient on her first visit showed that the right hand was flexed and the muscles of the forearm on the radial side were contracted, but the fingers were apparently normal. The patient also had inguinal hernia. The roentgenologic study (Fig. 3) revealed that the ulna on the right side was over-developed and curved, the convexity being at the posterior border, and that the radius was totally absent. The left side was normal. The patient returned at frequent intervals to the dispensary for manipulation of the deformed limb and application of cast and splint. On February 13, 1923, the patient was admitted to the Hospital for operative treatment.

The physical examination on admission was essentially negative, except for the right radial club-hand, the hand being abducted permanently, so that it was at a right angle to the long axis of the forearm. The muscles of the right arm were soft and flabby, but the action of these muscles and the movements at various joints of the arm and hand were fairly normal. The right thumb was slightly longer than the thumb on

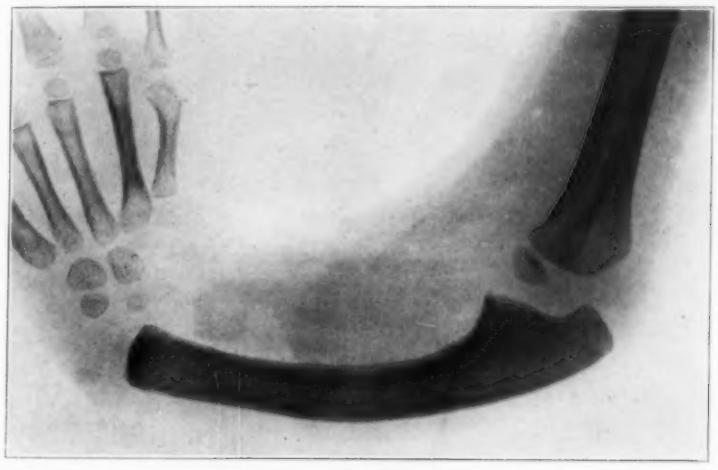

FIG. 3.

Radiograph of right forearm (Case 2), taken on October 5, 1922, showing the congenital absence of the radius and the typical hypertrophied and curved ulna. The secondary ossific center for the base of the first metacarpal bone, normally present at this age, has not yet appeared.

the left hand, and it could not be fully flexed. The radial pulse was not obtainable at the usual site, but there was a distinctly palpable pulse just ventral to the styloid process of the ulna. The patient had fairly good control of her right hand for the ordinary purposes of life.

On February 14, 1923, an operation on the deformed hand was performed by Dr. Edwin W. Ryerson, Attending Orthopaedic Surgeon, as follows: Under general ether anaesthesia, a curvilinear incision, about seven inches long, extending from the olecranon process of the right ulna, along the ulnar side of the dorsal surface of the forearm, to the dorsum of the wrist, was made through the skin and the superficial fascia. After a slight dissection, the greater part of the ulna was exposed, which was found to be greatly hypertrophied. The periosteum of the exposed ulna was cut through along the longitudinal axis of the bone by two parallel incisions, about half an inch apart, for a distance of about five inches, including the epiphyseal coverings of the distal end. The bone graft thus mapped out by the periosteal incisions was removed by means of the Hoglund electric motor saw, and on removal measured approximately 10 by 1.5 cm. by 1 cm. This was immediately immersed in physiologic saline. The ulna was then covered by sewing the fascia over the site of the defect made by the removal of the graft. The

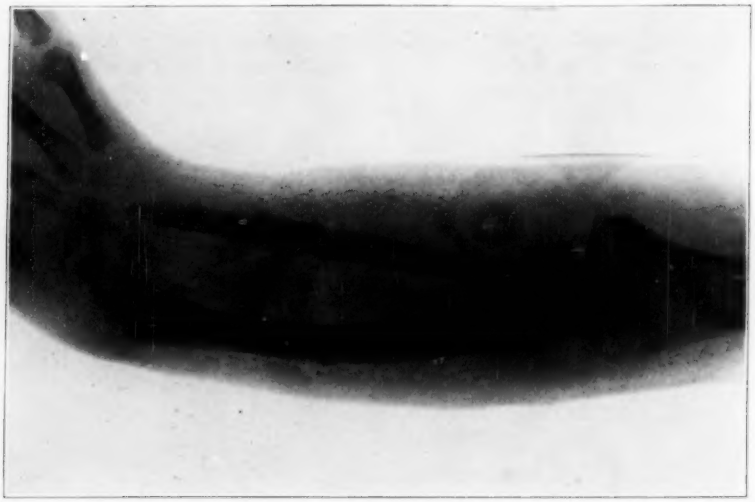

FIG. 4.

Radiograph of right forearm (Case 2), taken on March 6, 1923, showing the newly-made radius in position. The cortex of the ulna along the lateral aspect has been removed with the graft.

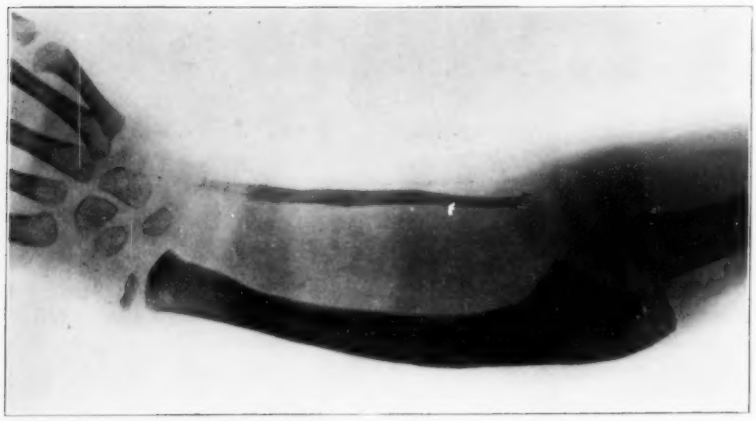

FIG. 5.

Radiograph of right forearm (Case 2), taken on October 1, 1923, showing the bone graft greatly absorbed but still serving the purpose of correcting the radio-palmar deviation. The centers of ossification for the head of the ulna and for the os multangulum minus have appeared.

graft was then inserted beneath the extensors of the forearm and hand, and fixed in place by suturing the fascia over it. After the skin incision wound was closed with continuous black silk, the arm was put in a plaster of Paris cast in extension (Fig. 4).

Eight months after the operation, the condition of the deformed forearm showed some improvement, the function of the hand was greatly restored and the deformity corrected to a satisfactory degree. Pronation and supination were readily accomplished.

FIG. 6.

Radiograph of left forearm (Case 3), taken on April 19, 1915, showing congenital defect of the distal end of the radius, where the bone is bifid, the hypertrophied and curved ulna, absence of the thumb with its metacarpal bone and the synostosis of the os capitatum and hamatum.

The thumb was used more adeptly and the grasping power of the hand was much stronger than before. The general atrophy of the entire arm, however, is still unchanged, the measurements being as follows:

TABLE I.

Measurements taken	*Left*	*Right*
Thumb, from base of proximal phalanx to tip	4.3 cm.	3.2 cm.
Index finger, from interdigital fold to tip	5.6 cm.	5.0 cm.
Middle finger, from interdigital fold to tip	8.1 cm.	8.1 cm.
Ring finger, from interdigital fold to tip	6.8 cm.	5.6 cm.
Little finger, from interdigital fold to tip	4.3 cm.	4.3 cm.
From olecranon to styloid process of ulna	16.5 cm.	12.0 cm.
From cubital fold to base of metacarpal I	17.1 cm.	9.4 cm.

The palpation of the right forearm reveals the graft in the superficial tissue, and apparently being absorbed. The radiographic film (Fig. 5) confirmed the fact that the

graft lies rather superficially, but it must be acknowledged that it had served the function of supporting the hand, which otherwise would have suffered a greater increasing deformity. The patient's arm at present time is supported in a specially constructed splint.

Case 3. B. S.; female. The radiogram of the radial defect is reproduced in Figure 6. On account of the failure on the part of the patient to return to the clinic, the data are lacking in the record.

REVIEW OF LITERATURE.

The first authentic case of congenital absence of the radius is perhaps that of Petit[5] who reported a case of newly-born male infant with bilateral club-hand due to total absence of the radius, although in the treatise on Monstrosities by Paré[6], we find the statement which reads, "L'an 1573, je vis à Paris, à la porte de St-André-des-Arts, un enfant monstreux, âgé de 9 ans, natif de Papeville, village à 3 lieues de Guise (son père s'appelait Pierre Renard, sa mère Marquette), qui n'avait que deux doigts à la main droite; et le bras droit était assez bien formé depuis l'épaule jusqu'au coude, mais depuis de coude jusqu'aux deux doigts était fort difformé. Il était sans jambes. Toutefois lui sortait hors de la fesse droite une figure incomplète d'un pied, apparence de quatre orteils; de l'autre fesse gauche, il en sortait du milieu deux doigts *quorum unus genitali virili haud erat absimilis.*"

It is surprising, however, to find that the authors who reviewed the literature on the subject have failed to collect all recorded cases up to the time of their respective writing. Gruber[7] was the first author to make a review of the literature and referred to 14 cases. Bouvier's article on "Main bote" contains two tables of recorded cases of congenital club-hand, in which we find 24 cases of this deformity due to complete or partial absence of the radius[8]. Herschel[9] presented his Inaugural-Dissertation to the University of Kiel in 1878, in which he reviewed 32 cases. Schmid[10] collected 48 cases on record and published a statistical study of these in 1890. In 1895, Kümmel[11] tabulated 67 cases which he had found in the literature up to that year. The most recent review of the subject, however, is that made by Antonelli[12], first published in Italian and later translated into German, in which 114 cases are analysed.

I have found 250 cases recorded up to the year 1923, and the three cases reported in this paper bring the total up to 253. These cases are chronologically reviewed herewith, each with the name of the author, the source, the principal pathology and the more important points of associated pathology (Tab. 1). Some of these cases are so inadequately described that no definite data can be obtained, while others are worked

out in minute details. A few cases are not described at all, but merely mentioned or referred to by certain authors without giving the source. Moreover, the fact that the earlier records are not accompanied by

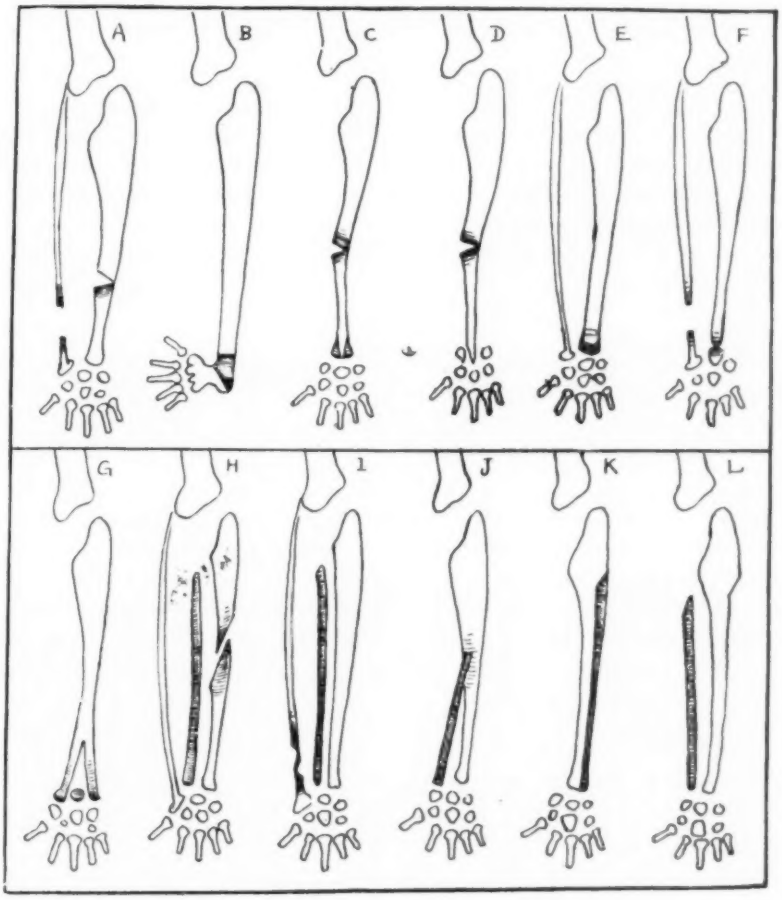

FIG. 7.

Diagrammatic summary of various operative measures. For explanation see text.

roentgenologic evidence puts us on our guard as to the correctness of diagnosis, unless verified by necropsy and dissection. Nearly all the later reports are fortified by radiographic records and, therefore, their diagnosis can hardly be questioned.

TABLE 2.

Abbreviations:

M=male	R=right	d=days
F=female	L=left	w=weeks
B=bilateral	f=fetus	m=months
U=unilateral	n=new-born	y=years
C=complete	s=stillborn	u=upper part
P=partial	p=premature	l=lower part

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
1.	Pétit, J. L.: Mém. d. l'acad. roy. d. sci., Paris, 1733, 17.	M, B, C, n	Double club-hand; metacarpal I and thumb absent.
2.	Friederici: Monstrum humanum rarissimum, Lipsiae, 1737.	s, f, B, C	Gross anomalies in other organs, etc.
3.	Wiedemann, C. R.: Beitr. f. d. Zergliederungskunst v. Isenflamm u. Rosenmüller, 1800.	n, U, R, C.	Hydrocephalus; harelip.
4. to 7.	Obertenffer, J. G.: D. Joh. Christian Stark's Arch. f. die Geb., Frauenzimmer-und Kinderkrankheiten, 2:4 stück (1801).	(1) F, U, LC. (2) F, 13y, U, RC. (3) M, 9y, U, RC. (4) F, B, C, 16y.	Atrophy of right arm.
8.	Joerg, J. C.: Ueber d. Verkrümmungen d. menschlichen Körpers, Leipzig, 1810.	U?, C?, n.	Thumb absent; ill-shaped fingers.
9.	Fleischmann, G.: Leichenöffnungen, Erlangen, 1815	f, 8m, B, C.	Hydrocephalus; syndactylism of toes.
10.	Meckel, J. F.: Arch. f. Anat. u. Physiol., 1826, p. 36.	F, f, B, RC, LP.	Hydrocephalus; right lung and left kidney absent; right kidney cystic with atresia of ureter.
11.	Cruveilhier, J.: Bull. soc. anat., Paris, 3:223 (1828)	M, f, B, LC, RP.	Many other defects.
12.	Manec, M.: Bull. soc. anat., Paris, Ann. 3, 1828, p. 224.	Adult, U, C.	
13. and 14.	Cruveilhier, J.: Atlas d'anat. pathol., 1, Bk. 2, 1829, pp. 2–3.	(1) f, B, C. (2) f, U, Pl.	Double club-hand; thumbs, metacarpal I and trapezium absent. Imperforate anus; thumb, metacarpal I and trapezium absent.
15.	Lediberder, M.: Bull. soc. anat., Paris, 3 s. (1836), 1:2.	M, 60d, U, RC.	Right thumb and metacarpal I, left scapula and arm absent.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
16.	Préstat and Giraldés: Bull. soc. anat., Paris, 1837, Ann. 12, pp. 167.	f, 6. 5m, B, C.	Pseudocephalic monster; only three fingers; imperforate anus; urethra and urinary bladder absent; scoliosis.
17.	Wiebers, de, J. F.: Nonnulla de prima formatione cohibita c. tab. aen., Berl., 1838.	M, f, U, RC.	Club-feet; left eye and nasal septum absent; atresia ani.
18.	Guérin, J.: Réchérches sur les luxations congénitales, Paris, 1841.	f, 6m, B, C.	Anencephalus; spina bifida; kyphosis; defect of 1–6 ribs.
19. to 25.	Otto, A. W.: Monstrum sexcentorum descriptio anatomica, 1841, p. 130 (Nos. 234–240).	(1) No. 234: F, 7m, B, C, f.	Other defects.
		(2) No. 235: M, 8m, B, C.	Other defects.
		(3) No. 236: M, n, B, C.	Other defects.
		(4) No. 237: M, f, 8m, U, L.	Contracture of right hand; other defects.
		(5) No. 238: M, n, B, C.	Other defects.
		(6) No. 239: M, f, 8m, B,C.	Left thumb rudimentary.
		(7) No. 240: M, f, 7m, U, L.	Left arm short; club-hand; thumb rudimentary.
26. to 28.	Vrolik, W.: Tabulae ad illustrandum embryogenesin hominis et mammalium, tam naturalem quam abnormen, Amstelodami, 1849.	(1) B, C.	Hand set tight at shoulder.
		(2) F, B, C.	Left forearm absent.
		(3) F, n, B, C.	Four fingers on each hand, the outer two being fused.
29. and 30.	Davaine: Compt. rend. soc. de biol., 1850, Paris, 2:39.	(1) f, 7m, U, L.	Club-hand; thumb absent; left humerus longer than right.
		(2) s, B, C.	Left ramus of mandible absent; dislocation of vertebrae and fusion of ribs.
31.	LeGendre, E. Q.: Mém. d. l. soc. de biol., Paris, 1851, s 3, 1:24.	F, 60y, U, Lu.	Club-hand; incurved ulna.
32.	Roger, H. et Houél: L'union méd., Paris, 1851, 5:562.	M, 10d, B. C.	Club-hand; both thumbs absent.
33.	Rombeau, M.: Bull. soc. anat., Paris, Ann. 27 (1852), p. 414.	9, 5y, U, L.	Scaphoid, trapezium, metacarpal I and thumb absent.
34.	Lédru: Bull. soc. anat., Paris, 1855, 30:269.	M, 5d, B, C.	Born with crossed hands.
35.	Silvester, H. R.: Med. Times and Gaz., 1857, N. S., 16:643.	B, RC, LPl.	

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
36.	Erichsen: Lancet, London, 1858, 1:605.	Child, 2y, U.	Thumb and metacarpal I absent; index finger rudimentary.
37. and 38.	Förster, A.; Die Missbildungen d. Menschen nebst Atlas, Jena, 1861, Lief. I, p. 65.	(1) f, 8m, B, C.	Scaphoid, trapezium, trapezoid absent; only three metacarpals; only two fingers.
		(2) U, l.	Thumb absent.
39.	Wagner, E.: Würzburger med. Ztschr., 1862, 3:44.	f, 7m, B, C.	Club-hand; only two fingers on right; one finger on left.
40.	Voigt, L.: Wagner's Arch., Leipzig, 1863, 4:27.	M, n, U, LC.	Club-hand; club-feet; blue baby; left thumb absent; hydronephrosis.
41.	Stricker, W.: Virchow's Arch., 1864, 30:529.	F, 16w, B, C.	Club-hand; short arms; both thumbs absent.
42.	Gruber, W.: Virchow's Arch., 1865, 33:228.	F, 35d, B, C.	Synostosis of metacarpals 4–5; horse-shoe kidney.
43.	Swaagmann, P. H.: Virchow's Arch., 1865, 33:228.	M, 9m, U, RC.	Rudimentary radius on left; club-hand; both thumbs absent.
44.	Virchow, R.: Virchow's Arch., 1865, 32:518.	M, n, U, RC.	Club-feet; atresia ani et urethrae; right branchial fistula; patent ductus Botalli.
45. and 46.	Dornseiff, O.: Zur Aetiologie d. congenitalen Luxationen d. Hand- u. Fussgelenkes, Giessen, 1866.	(1) f, p, U, RC.	Left radius and thumb rudimentary; right thumb absent.
		(2) f, B, C.	Luxation of all joints; unilateral absence of tibia.
47.	Gruber, W.: Virchow's Arch., 1867, 40:427.	M, f, U, LPl.	Talip-manus vara; hydrocephalus; harelip and cleft palate; diaphragmatic hernia; horse-shoe kidney; double hip dislocation; club-feet.
48.	Coles, G. C.: Tr. Path. Soc., Lond., 1869, 20:417.	20y, U, R, C.	Left scapula rudimentary; both thumbs absent.
49.	Larréy: Gaz. des Hôpit., 1870, 43:367.	M, 25y, B, C.	Left thumb absent; vertebrae, left thorax and left mandible deformed.
50. to	Bouvier: Dict. encyclop., art. "Main bote," 1871, 4:171 (Tab. D).	(1) Case 22:— M, f, 8m, B, C.	Thumb and metacarpal I absent.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
54.		(2) Case 24:— f, 9m, U, LPl.	Metacarpal V absent; thumb articulates with metacarpal II.
		(3) Case 25:— f, 9m, B, C.	Double radio-palmar deviation.
		(4) Case 26:— f, 9m, U, LC.	Metacarpal I absent.
		(5) Case 27:— F, 27m, U, LC.	Left radio-palmar club-hand; thumb and carpus absent.
55.	Despretz: Communication to Bouvier, ibid., p. 173 (Tab. D)	Case 30:— M, 50y, U, C.	Thumb absent; cubito-palmar club-hand.
56. and 57.	Henzschel, O.: Beitrag zur Casuistik d. angeborenen Radiusdefekt, Halle, 1872.	(1) M, f, 7m, B, C.	Thymus absent; umbilical hernia.
		(2) M, f, 5m, B, C.	Tracheo-esophageal fistula; anomaly of great vessels.
58.	Coulon, N.: Bull. soc. anat., Paris, 1875, s 3, 10:497.	s, f, U, LC.	Both thumbs absent; left club-hand.
59.	Letulle, M.: Bull. soc. anat., Paris, 1875, s 3, 10:309.	1m, U, RC.	Right arm immobile; rudimentary thumb.
60.	Polaillon: Bull. et Mém. d. l. soc. d. chir., Juillet, 1875. (Centralbl. f. Chir., 3:416).	n, B, C.	Atresia ani.
61. and 62.	Schnelle, A.: Ueber angeborenen Defect von Radius u. Ulna, Göttingen, 1875.	(1) F, 21y, U, RC.	Radial club-hand; thumb absent.
		(2) F, f, 8m, U, LC.	Thumb absent; double hare-lips and cleft palate.
63.	Hodge, H. L.: Tr. Path. Soc., Phila., 1875–76, 6:4.	M, 70y, C.	Curved ulna.
64.	Kaczander, J.: Virchow's Arch., 1877, 71:409.	s, p, U, LC.	Thumb, scaphoid and trapezium absent.
65.	Herschel, W.: Beitr. zur Kasuistik u. zur Theorie d. congenitalen Radiusdefectes, Kiel, 1878.	F, 12y, U, RC.	Club-hand; torsion curvature of hand; thumb absent; right hare-lip.
66.	Nicolaysen: Norsk. mag., 3 R, 1879, 12, 4, 22.	12w, B, C.	Club-hand; thumb and metacarpal I absent.
67. to 69.	Flachsland, J. C.: Observationes pathologico-anatomicae, Rastadü, lit. s oinzingianis, 1880.	(1) B, C.	Both forearms and lower legs absent; hands and feet attached to upper arms and thighs.
		(2) B, C.	Lower legs absent.
		(3) B, C.	Arm very short; both lower legs absent.
70.	Pasquali: Bol. d. roy. acad. med. di Roma, 1880, 6:6.	M, B, C.	Rudimentary thumbs; metacarpal I absent on both sides; defective carpus.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
71.	Peterson, O.: St. Petersburg med. Wchnschr., 1880, 5:383.	M, 31y, U, LP.	Only diaphysis absent; syphilis.
72.	Anders, E.: Jahrb. f. Kinderh., 1881, 16:435.	M, 14d, U, LC.	Thumb absent.
73.	Hellmuth, K.: Zur Kasuistik d. Missbildungen etc., Erlangen, 1881.	M, f, 6m, B, C.	Club-feet; atresia ani et urethrae; single auricle; defect septum interventriculi.
74. and 75.	Parker, R. W.: Tr. Path. Soc., Lond., 1882, 33:236.	(1) M, 12y, B, C.	Carpus, left thumb and metacarpal I absent.
		(2) M, 2y, B, C.	Both tibiae absent; supernumerary and irregular toes.
76.	Hildemann, A.: Beitrag zur Casuistik d. angeborenen Hemmungsbildungen d. Extremitäten, Kiel, 1882.	M, 12w, U, RC.	Club-hand; fleshy stump for thumb; metacarpal I and its phalanges absent.
77. to 80.	Shattock, S. G.: Tr. Path. Soc., Lond., 1881–82, 33:240.	(1) M, f, 9m, U, RC.	Thumb, scaphoid and trapezium absent.
		(2) f, p, U, LC.	Thumb and scaphoid absent.
		(3) f, 6m, B, C.	Thumb, index fingers, scaphoid, trapezium and trapezoid absent.
		(4) f, 9m, U, C.	Undeveloped thumb and index fingers.
81.	Sayre, L. A.: Orthopedic Surgery and Diseases of the Joints, London, 1883, 2nd ed., p. 161.	F, 6m, U, Ll.	
82.	Guermonprez, F.: Bull. et Mém. d. l. soc. d. chir., Paris, 1884, p. 721.	M, 27y, U, LC.	Metacarpal I absent; thumb rudimentary.
83. and 84.	Ehrlich, N.: Virchow's Arch., 1885, 100:107.	(1) F, f, U, LC.	Club-hand; only two fingers; short humerus; double clavicle.
		(2) F, f, 6m, U, RPl.	Short right arm; club-hand; right club-foot; tibia incomplete.
85.	Muralt, v. : Cited by Burckhardt, L.: Jahrb. f. Kinderh., 1890, 31:375.	M, 18m, U, LC.	Left thumb small and its metacarpal absent.
86.	Geissendörfer, W.: Zur Casuistik d. congenitalen Radiusdefectes, München, 1890.	F, 10w, B, C.	All joints weak; right radial artery absent; left flat-foot.
87.	Schulthess, W.: Correspondenzbl. f. Schweizerärzte, 1890, 20:44.	F, 12y, U, RP.	Thumb doubled.
88.	Birnbacher, G.: Drei Beobachtungen über Verkümmerung der oberen Extremitäten, Königsberg, 1891.	F, 12d.	Contracture of elbow, wrist and fingers.
89. and 90.	Jacobi, C.: Zur Aetiologie und Therapie des congenitalen Radiusdefectes, Leipzig, 1891.	(1) F, 8m, B, C.	
		(2) M, 10m, U, RC.	Torticollis.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
91. and 92.	Bajardi, D.: Soc. ital. d'ortop., 1892.	(1) F, 2m, B, Pl.	Club-hand; syndactylism of left thumb and index finger, with absence of metacarpal I; genu recurvatum; both patellae absent.
		(2) F, 2m, U, Pl.	Ankylosis of elbow; deformity of hip-joint; pes varus.
93. and 94.	Hutchinson, J.: Arch. Surg., Lond., 1891–92, 3:299.	(1) 6w, B, LC, RPu.	Symmetrical arm defect.
		(2) M, B.	Right thumb and index finger absent; syndactylism of left digits 2–3.
95. and 96.	Kirmisson, E. et Saiton, R.: Rev. d'orthop., Paris, 1892, 2:108.	(1) M, 9m, B, LPl, RPl.	Club-hands; digit 1 stunted; atrophy of alae of right auricle; large head; internal strabismus.
		(2) M, 8m, U, RPl.	Head asymmetrical; angioma on cheek; scar-like depression over distal end of ulna; only three fingers.
97.	Warfield: Johns Hopkins Hosp. Bull., 1892, 3:42.	M, 14y, B, C.	Both thumbs absent; all carpus absent; except pisiforme; no radial pulse.
98. and 99.	Schmid, O.: Ztschr. f. orthop. Chir., 1892, 2:59.	(1) F, 14y, B, Pu.	Doubling of digit V.
		(2) M,5y,U,Ru.	Rickets.
100. to 103.	Bardenheuer, B.: Verhandl. d. deutsch. Gesellsch. f. Chir., Leipzig, 1893, XXIII Kongres, pp. 105–107.	Four cases reported with treatment, but no description of pathology.	
104. and 105.	Kirmisson et Longuét: Rev. d'orthop., 1893, 4:59.	(1) F, 13m, U, RC.	Scaphoid, semilunar, trapezium and thumb absent.
		(2) M,9m,B,P.	(Same as 87 above).
106.	Sayre, R. H.: Tr. Am. Orthop. Ass., 1893, 6:208.	M, 9y, B. C.	One digit and carpal bones absent.
107.	Cohen: Virchow's Arch., 1894, 137: 387.	F, 17y, U, RC.	Five small fleshy stumps as fingers.
108.	Krönig: Centralbl. f. Gynäk., 1893, 18:171.	14d, B.C.	Hydrocephalus.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
109. to 112.	Rincheval: Arch. f. klin. Chir., 48:802 (1894).	(1) M, 6m, U, RC.	Club-hand; thumb rudimentary; distal end of metacarpal I absent.
	Also mentioned by Antonelli, I.: Gazz. Med. Ital., 55:501.	(2) M, 7w, U, R, Pl.	Club-hand; two middle metacarpals and thumb absent; two middle digits webbed with pressure furrow; patella and tibia absent.
		(3) M, n, U, RC.	Atresia ani.
		(4) M, 23w, U, RC.	Hare-lip and cleft palate; interventricular septum defect; horse-shoe kidney; flat foot.
113.	Romano, C.: Arch. di ortop., 11:80 (1894).	F, 6y, U, RC.	
	Büttmann: Beitrag zur Kasuistik des kongenitalen Radiusdefektes. In.-Dis., Leipzig, 1895.	Reports case 2 mentioned by Buchbinder: q.v.	
114.	Enders: cited by Antonelli, I.: q.v.	U, L. C.	Large umbilical hernia; malformation of genitals; pes varus.
115. and 116.	Joachimsthal, G.: Arch. f. klin. Chir., 50:496 (1895).	(1) M, 10y, U, LC.	Left thumb, metacarpal I, semilunar and trapezium absent; right thumb absent.
		(2) M, 8y, U, L, Pu.	Rudimentary thumb; Club-foot.
117. to 122.	Kümmel, W.: Bibliotheca medica, Abtheilung E (Chir.), Ht. 3, Kassel, 1895.	(1) M, 23y, U, RC. (Mikulicz's case).	Large head; Thumb and metacarpal I absent.
		(2) F, 14d, B. C. (Mikulicz's case)	
		(3) F, 1½d, U, RC.	Atresia ani; stump-like thumb attached to metacarpal II.
		(4) M, 2d, U, RC. (Küstner's case)	Hare-lip; cleft palate; left auricle and ext. aud. meatus absent; pes calcaneo-valgus.
		(5) M, n, B.C. (Hasse's case)	Left kidney absent; flat foot; rudimentary shoulder.
		(6) M, 29y, B. C. (Kast's case)	Left thumb; kyphosis; coloboma of iris and choroid; blindness.
123.	McCurdy, S. LeR.: Tr. Am. Orth. Ass., 8:8 (1895).	F, 10m, B. C.	Club-hand.
124.	Mikulicz: cited by Antonelli, q.v.	M, 2m, B, Pl.	

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
125	Phocas: cited by Antonelli, q.v. Schubert: Ein Beitrag zur Kasuistik des kongenitalen Radiusdefektes. In.-Dis., Leipzig, 1895.	M, 1m, U, C. Reports case 3 of Buchbinder, q.v.	
126. to 130.	Buchbinder, H.: Chir. Beitr., Festschr. f. Benno Schmidt, Leipzig, 1896.	(1) M, 23d, BP.	Muscle anomalies.
		(2) M, B, C, s. (Büttmann's case.	Both thumbs absent; interventricular septum defect.
		(3) 4y, U, RC. (Schubert's case)	Pes valgus with pronation contracture; thumb absent.
		(4) M, 4m, U, RC.	Thumb absent.
		(5) M, U, RC. (Rissmann's case)	Thumb absent; carpus fails; club-hand.
131.	Cuff, A.: Clin. Sketches, London, 3:41 (1896).	Adult, B. C.	Syphilitic bone changes.
132. and 133.	Hlawacek: Deutch. Ztschr. f. Chir., 43:140 (1896).	(1) M, 38y, B, C.	
		(2) 6w, B, C.	
134. and 135.	Hutchinson, J.: Arch. Surg., London, 7:271 (1896).	(1) F, 5y, B, C.	Radial club-hand.
		(2) F, 10w, B, C.	Thumbs absent.
136.	Joachimathal, G.: Berl. klin. Wchnschr., 33:356 (1896).	M, f, 5m, B, C.	Thumbs with metacarpal I absent.
137.	Rerrando, J.: J. de clin. et de thérap. inf., Paris, 4:423 (1896).	M, 4m, U, RC.	Hemiatrophy of face; congenital torticollis.
138.	Thompson, C. E.: Tr. Am. Orth. Ass., 9:165 (1896).	F, 17y, B, C.	Club-hands.
139.	Vulpius, O.: Deutsch. med. Wchnschr., 22:480 (1896).	C.	
140.	von Stubenrauch: Sitzungsb. d. Aertzl. Vereins München, 7:27 (1896–97).	M, 11y, U, RC.	Ankylosis of metacarpo, phalangeal joints; thumb-metacarpal I, trapezium and scaphoid absent.
141. to 144.	McKenzie, B. E.: N. Y. Med. J., 65:241 (1897).	(1) F, 45y, B. C.	Right thumb and index finger absent; left arm absent.
		(2) 6m, U, RC.	Thumb rudimentary.
		(3) M, 12y, B. C.	Thumb and metacarpal I absent; transposed radial artery.
		(4) M, 6m, U, RC.	Thumb and metacarpal I absent.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
145. and 146.	Monguidi, C.: Arch. di ortop., 14: 145 (1897).	(1) n, B, RC, LPl.	Oro-orbital fissure; syndactylism; pes equino-varus.
		(2) f, B, LC, RPl.	Permanent flexion of forearms; amputation of 4 fingers.
147.	Mathews, W. P.: Med. Reg., Richmond, Va., 1:29 (1897).	F, 14m, U, LC.	Both thumbs absent.
148. and 149.	Taylor, H. L.: Tr. Am. Orthop. Ass., 10:170 (1897).	(1) f, 5w, B. C.	Weakness of left knee with tendency for subluxation.
		(2) f, 2w, U, RC.	Club-hands; both thumbs and metacarpal I absent.
150.	Johnston, G. B.: Med. Reg., Richmond, Va., 1:29 (1898). Referred by Mathews, q.v.	M, 13y, U, LC.	
151.	Kirmisson, E. et Saiton, R.: Rev. d'orthop., 9-35 (1898).	F, 4m, B, RPu, LPu.	Double club-hands.
152.	Middleton: Glasgow Med. J., 50: 244 (1898).	M, 38y, U, LC.	Kyphosis; muscle atrophy; thumb absent.
153.	Nové-Josserand (1898). Cited by Antonelli: Gazz. Med. Ital., 1904, 55:501.	F, 3y, U, RC.	Thumb and index finger atrophied; atrophy of fingers.
154.	Takada, S.: Ztschr. d. med. Gesellsch. zu Tokyo, 12:973 (1898).	M, 50d, B.C.	Double club-hands.
155.	Pagenstecher, E.: Deutsch. Ztschr. f. Chir., 50:427 (1898-99).	F, 17y, B.C.	Three fingers on left, two on right; right arm absent.
156.	Tschmarke, P.: Ztschr. f. orthop. Chir., 8-368 (1898-99).	M, 10y, U, LPu.	Polydactylism (seven fingers); thumb has three phalanges.
157.	Bardeleben, von K.: Deutsch. med. Wchnschr., 25:221 (1899).	3y2m, B.C.	Double club-hands.
158.	Savorin, A.: Contribution à l'étude de l'absence congénitale du radius (main-bote), Lyon, 1899. Thèse de Paris.	F, 3½y,U,RC. (Siraud's case)	Thumb a mere stump, immobile and useless; metacarpus rudimentary.
159.	Stouffs: Bull. soc. belge de gyn. et d'obst., Brux., 10:124 (1899-1900).	M, n, B, C.	Club-hands; both thumbs absent; hypospadias; cryptorchism.
160.	Thompson, J.: Tr. Obst. Soc., Edinburgh, 15:56 (1899-1900).	F, 16y, B, Pu.	Both thumbs absent; small hands.
161 to 165.	Klaussner, F.: Ueber Missbildungen der menschl. Gliedmassen u. ihre Entstehungsweise, Wiesbaden,1900.	(1) f, B, C.	Thumbs absent; four fingers on each.
		(2) f, B.C.	Fixation of elbow.
		(3) n, U, LC.	Thumbs absent; only three fingers on right; club-hand.
		(4) F, 16y, U, RP.	Thumb absent; club-hand; subluxation.
		(5) von Stubenrauch's case.	

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
166. to 175.	Leprince, H.: Contribution à l'étude de la main-bote congenitale., Paris thesis, 1900.	(1) F, U, RC.	Thumb and metacarpal absent; depression of thena eminence.
		(2) M, 13m, U, RC.	Thumb absent; only three fingers, with rudimentary fourth; muscle defects.
		(3) M, 1m, U. RC.	Thumb rudimentary.
		(4) M, 9y, U, C.	Club-foot; carpus incomplete.
		(5) M, 2m, B, C.	Syndactylism of digits I and II; bilateral absence of patellae; genu valgum (left).
		(6) M, 5d, B, C.	Muscle anomalies.
		(7) f, 5m, U, RC.	Thumb and metacarpal I absent; bilateral club-feet.
		(8) U, LC.	Four fingers on right hand.
		(9) M, n, B, C.	Annular ligament absent.
176.	Piéchaud, T.: cited by Antonelli, q.v.	U, RP1.	
177.	Gayét, G.: Gaz. des Hôp., Paris, 1901, 74:345.	(1) F, U, RC.	Bilateral club-hand and both thumbs absent; mother had same deformity.
		(2) M, 50y, U, C.	(Same case as reported by Bouvier in 1870, No. 55.)
178.	Longuét et Peraire: Bull. et Mém. soc. anat., Paris, 6s., 3: 147 (1901).	F, 19y, U, RC.	Generalized infantilism; convergent strabismus.
179.	Park, R.: Tr. Am. Orthop. Ass., 14; 146 (1901).	F, 14y, U, LC.	Thumb and metacarpal I absent.
180.	Cranwell, D. J.: Rev. soc. med. argent., Buenos Aires, 11:540 (1903).	M, n, B.C.	Club-hands; rudimentary thumbs.
181.	Franz: Münch. med. Wehnschr., 50(1): 1009 (1903).	B.C.	Thumbs and metacarpal I absent.
182.	Kiwull, E.: Fortschr. auf dem Geb. d. Röntgenstr., 6:185 (1903).	M, 37y, U, RC.	Fusion of rudimentary ulna and radius (?).
183.	Kraemer u. Kronacher: Aertl. Verein, Nüremberg, Munch. med. Wehnschr., 50 (1):274 (1903).	1½y, U, RC.	Right hand absent; ulna rudimentary on right.
184.	Malewski, B.: Medycyna, Warszawa, 1903, 21:235.	B.C.	
185.	Rédard, P.: Rev. d'orthop., 2 s., 4:247 (1903).	2y, U, RP1.	Right club-hand; marked deformity of right arm.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
186.	Michelsohn, J.: Ztschr. f. orthop. Chir., Stuttgart, 12:445 (1904); also Deutsch. med. Wchnschr., 32: 1:357 (1904).	M, 2½y, U, LC.	Left thumb and metacarpal I absent; radial carpus absent.
187.	Blencke, A.: Ztschr. f. orthop. Chir., 12:380 (1904).	M, 27y, B.C.	Split uvula.
188 and 189	Blencke, A.: Ztschr. f. orthop. Chir., 13:654 (1904).	(1) F, B, C. (2) F, B. C. (3) M, B.C. (4) M, B.C.	These four cases are the first, second, seventh and ninth children of same family. All had club-hands due to total absence of radius.
190.	Reisz, O.: Gyogyaszat, Budapest, 44:727 (1904).	F, 20y, B, C.	Clinodactylic fingers; club-hands.
191.	Antonelli, I.: Gazz. Med. Ital., Torino, 55:501; 55:519; 56:81 (1904) Also Ztschr. f. orthop. Chir., 14:213 (1904).	M, 5m, B, C.	Club-hands; hypospadia peno-scrotalis; right inguino-scrotal hernia; pes plano-varus.
192.	Becker: Centralb. f. Gynäk., 29(2): 1421 (1905).	M, 2½m, U, RC.	Thumbs deformed.
193.	Bruno: Münch. med. Wchnschr., 52 (1): 724 (1905).	F, 4½y, B, C.	Club-hands; thumbs, scaphoid, trapezius absent.
194.	Chance, E. J.: Bodily Deformities, 2 vols., Lond., Vol. I, p. 22 (1905).	U, C.	Ulna and thumb absent; only three fingers.
195.	Huisman, M. A.: J. méd. de Brux., 10:670 (1905).	F, 1y, B, C.	Thumbs in extension; fibrous cord at wrist.
196.	Jagot, L.: Arch. méd. d'Angers, 9: 161 (1905).	F, 8y, U, L.C.	Semilunar, cuneiform, pisiforme, os magnum, unciform absent.
197.	Levy: Centralb. f. Gynäk., 29(1): 534 (1905).	F, 6m, B, C.	Thumbs absent.
198.	Scheffczyk: Centralb. f. Gynäk., 29 (2): 1420 (1905).	U, RC.	Club-hands and club-feet.
199.	Francois, H. et Egger, M.: N. iconog. de la Sâlpetrière, Paris, 19: 463 (1905).	F, 22y, C.	Thumb, scaphoid and trapezium absent.
200.	Kupperstich: Path. Samml. zu Göttingen, quoted by Loebell, q.v., p. 21.	F, B, C.	Deformed leg.
201. and 202.	Loebell, G. E. A.: Ueber congenitalen Radiusdefect, Giessen, 1906. (These two cases quoted by Loebell are from Canstatt's Jahresbericht, 4, and Bull. de la soc. Philomat., Paris, Ann. III, but no dates given).	(1) M, 2m, B,C. (2) M, B, C. (credited to Duméril).	Forearm and hand absent. Both upper and forearms absent; deformities of legs.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
203.	Lotsch, F.: Deutsch. Ztschr. f. Chir. 82:530 (1906).	M, 4m, U, RC.	Thumbs absent.
204.	Moussaud,: Canstatt's Jahresbericht, 4 (Cited by Loebell, G.E.A.: Ueber congenitalen Radiusdefect, Giessen, 1906).	M, U, C.	Left forearm and hand absent; right middle finger absent.
205.	Muscatello, G.: Arch. di ortop., Milano, 23:366; also Boll. d. soc. med.-chir., Pavia, 1906, p. 170.	1y, B.C.	
206.	Reinhardt-Natvig,Christiana, quoted by Loebell, q.v., p. 27.	M, 29y, B, C.	
207.	Rocher, M.: J. de med. de Bord., 36:362 (1906).	M, 28d, U, LC.	Club-hand; thumb absent; atrophy of arm.
208.	Garipuy: Bull. et mém. soc. anat., Paris, 82:174 (1906).	M, n, U, LC.	Only two fingers; atrophy of brachial plexus.
209.	Illyés, C.: Orvosi hetilap, Budapest, 51:36 (1907).	B, C.	Weakness of hands.
210.	Layral, V. et Péju, G.: Prov. méd., Paris, 20:628 (1907).	F, 15y, U, LC.	Scaphoid, trapezium, metacarpal I, thumb and phalanx I absent.
211.	Poncét, M.: Lyon méd., 108:17 (1907).	M, U, RC.	Radial carpus, thumb and metacarpal I absent.
212.	Van Haelst, A.: Bull. soc. d. méd. de Gand., 74:177 (1907).	F, 1m, U, LC.	Left thumb absent; index finger rudimentary; right thumb mere pedicle; left torticollis.
213.	Bülow-Hansen, V.: Norsk. Mag. f. Laevidensk., Kristiana, 5R, 6: 956 (1908).	1y, B, C.	
214.	Gilbert et Jarricot: Reunion obst. de Lyon, April, 1908.	F, (Alecanus), U, RC.	Club-hand; thumb absent.
215. and 216.	Goerlich, M.: Beitr. zur klin. Chir., Tübingen, 59:421 (1908).	(1) M, 11½y, B, C. (2) UP.	Thumb absent.
217.	Gonnét: Bull. soc. d'obst., Paris, 11:210 (1908).	F, 5m, U, LC.	Club-hand; thumb, metacarpal I absent.
218. to 223.	Stoffel, A. u. Stempel, E.: Ztschr. f. orthop. Chir., 23:1 (1908).	(1) U, RC. (2) U, LP, l. (3) B, RC, LPl. (4) B, C. (5) B, C. (6) U, LPl.	All are cases of museum preparations with dissection.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
224. and 225.	Fabre et Jarricot: Bull. soc. d'obst., Paris, 13:212 (1910).	(1) f, s, B, C.	Club-hands; thumbs absent.
		(2) B, C.	Four fingers on left; three on right.
226.	Tubby, A. H.: Proc. Roy. Soc. Med., London, 4, Pt. 1, No. 7, p. 164 (1911).	8m, B, C.	
227.	Codét-Boisse: J. méd. de Bord., 42: 601 (1912).	M, U, RC.	Thumb and metacarpal I absent.
228.	Lehle, A.: Deutsch. mil. ärztl. Ztschr., Berlin, 41:928 (1912).	p, 4w, B, C.	
229.	Roederer, K.: Bull. de la soc. de ped. de Paris, 14:512 (1912).	U, LPl.	Left thumb rudimentary, metacarpal I absent.
230.	Roschke, E.: Ein Fall von doppelseitigem Radius-defect. Inaug.-Diss., München, 1912.	1m, B, C.	Double club-hands.
231.	Lorenz, A.: Wien. med. Wchnschr., 63:1052 (1913).	M, 7y, B, C.	Club-hands; right pes calcaneo-valgus; left pes valgus.
232.	Infante, C.: Atti. del. I. Congr. ital. di radiol. med., 1:154 (1913).	F, B, C.	Atrophy of hands.
233.	Bebes, A. A. u. Serbanescu, L.: Malformatiuni ale membruli superior, Spitalul, Bucharest, 34:263 (1914).	F, 26y, U, RC.	Bilateral clinodactyly.
234.	Roederer, C. et Bouvaist, M.: Rev. d'orthop., 3 s., 5:129 (1914).	n, U, LC.	Club-hand; left metacarpal I rudimentary.
235.	Schaeffer, J. P. and Nachamofsky, L. H.: Anat. Rec., Phila., 8:1 (1914).	M, 1d, B, C.	Both arms fixed in pronation.
236.	Milne, J. A.: Brit. Med. J., 2:821 (1915).	F, 16y, B, C.	Club-hands.
237.	Secord, E. R.: Ann. Surg., Phila., 61:381 (1915).	B, C.	Papulo-squamous eruptions.
238.	Lewin, P.: Am. J. Roentg., 4:431 (1917).	M, 9y, B, LC, RPl.	Double club-hand; both thumbs absent; only three carpal bones.
239.	Oidtmann, A.: Nederl. Tijdschr. v. Geneesk., 1:2172 (1917).	M, 7m, U, RC.	Club-hand.
240.	Apert et Morisétti: quoted by Restemeier: Deutsch. Ztschr. f. Chir., 155:120 (1920).	B, C.	
241.	Lestache, G.: Pediatria esp., 7: 91 (1918).	M, 9d, B, C.	All carpal bones absent.
242.	Restemeier; Deutsch. Ztschr. f. Chir., 155:120 (1920).	M, 3y, U, C.	Doubling of ulna; 7 metacarpal bones; thumb absent; doubling of unciform and os magnum.
243.	Simonini, A.: Clin. ped., Modena, 1:175 (1919).	M, 5y, U, RC.	Thumb and metacarpal I absent.

NO.	AUTHOR AND SOURCE	RADIAL PATHOLOGY	ASSOCIATED PATHOLOGY
244.	Johanson, S.: Hygiea, Stockholm, 84:81 (Feb. 15, 1922).	B, C.	
245.	Mourad, A.: Lancet, Lond., Dec. 9, 1922, p. 1222.	M, 2y3m, U, LC.	Thumb and metacarpal I absent; imperforate anus; partial webbing of left digits 2-3.
246. and 247.	Bertwistle, A. P.: Brit. Med. J., Feb. 24, 1923, p. 325.	(1) M, 18y, U, LC.	Thumb, scaphoid and trapezium absent; syndactylism of digits 2-3; inguinal hernia.
		(2) M, 30y, U, LC.	Right thumb, scaphoid, and trapezium absent; trophic changes in fingers.
248. and 249.	Jones, Sir R. and Lovett, R. W.: Orthopedic Surgery, 1923, p. 525.	(1) F, B, C.	No description.
		(2) F, B, C.	No description.
250.	Spears, L. P.: Kentucky Med. J., 21:407 (1923).	20 m, B, C.	Club-hands.
251. to 253.	Kato, K.: This Journal. (1923).	(1) M, 2½ y, B, C.	Double club-feet; left thumb absent; right thumb held by thin tissue, later dropped off.
		(2) F, 6y, U, RC.	Misplaced radial pulse; inguinal hernia; atrophy of right arm.
		(3) F, U, P.	

PRINCIPAL AND ASSOCIATED PATHOLOGY.

The pathology of congenital absence of the radius has been studied quite accurately and minutely by Antonelli and more recently by Stoffel and Stempel[13], so that any attempt to dwell in detail is a useless repetition. The results of our review may be tabulated statistically as follows:

TABLE 3.

SUMMARY OF PRINCIPAL PATHOLOGY.

Nature of Pathology	No. of Cases	Per Cent
Bilateral complete absence	107	46.1
Unilateral complete absence (total)	98	38.8
(1) Right side	53	21.5
(2) Left side	34	13.5
(3) Not stated	11	4.7
Bilateral partial absence	4	.8
Unilateral partial absence (total)	28	11.1
(1) Right side	10	4.4
(2) Left side	16	6.3
(3) Not stated	2	.4
Bilateral mixed (one side complete, the other partial)	4	.8
Total	253	

TABLE 4.

SUMMARY OF AGE AND SEX.

Age and Sex	*No. of Cases*	*Per Cent.*
Foetus or prematurely-born	46	18.2
Newly-born or still-born	19	7.5
Under 1 year of age	55	21.8
Under 5 years of age	20	7.9
Under 10 years of age	11	4.7
Under 25 years of age	27	10.4
Over 25 years of age	17	7.1
Age not stated	58	22.4
Male	104	40.9
Female	63	25.0
Sex not given	86	34.1

From the above tables it is clear that in over 46 per cent. of the cases, the deformity occurs bilaterally and that over 40 per cent. are in male children. It is also interesting to note that the great majority of the subjects were either prematurely-born or under one year of age.

The almost constant finding is the general atrophy of the extremity affected. The shoulder may appear small and thin, or it may be entirely normal. The upper arm usually shows a fairly normal conformation, except the flabbiness of musculature. The forearm is the seat of the greatest deformity. It is invariably short and stunted. Due to the hypertrophy and curvature of the ulna, it always appears curved with the convexity on the posterior side. The hand usually shows a deviation, causing what Bouvier has called the radio-palmar variety of club-hand. Often the hand is at a right angle to the long axis of the forearm, or the medial surface of the forearm may even be in actual contact with the hand. The hand is frequently small and atrophied. The absence of the thumb is a rather constant finding, and, in a few cases, the thumb was merely a stump of soft tissue held loosely to the radial side of the hand. The bifid thumb was reported by Kümmel, while Schmid recorded a supernumerary thumb. The other fingers may be normal, but often there is either total absence of one or more fingers or some defect such as syndactylism or polydactylism (as in the case reported by Tschmarke, in which seven fingers were found). In spite of the general atrophy and other associated defects of the arm, the function is usually good, although the grasping power is feeble. It is also interesting to note the occasional occurrence of certain skin markings, such as depressions and scar-like

dimples on the skin of the forearm. The articulation of various joints is in the majority of cases normal, but many cases are on record in which the movements were greatly restricted due to the luxation and weakness of the joints or to the contracture of muscles.

The skeletal development of the extremity, either with total or partial absence of the radius, is often accompanied by other abnormalities. The scapula in some cases is reduced in size and presents an atrophied appearance, but usually it is unchanged. The clavicle on the affected side may be shorter and more curved than the normal. The humerus often presents an anomaly near the head, which may be broad or present abnormal facets. The intertubercular sulcus is sometimes wanting, or it may be divided into major and minor sulci. Some authors found the humerus to be longer than usual, while others described cases in which it was rudimentary or curved. In the diaphysis, Rincheval noted a sulcus of strangulation in the lower third. In some cases the lower end of the bone was lacking, while in others there was an abnormality in the conformation of the internal condyle and of the trochlea. The radius itself is most frequently totally absent, but it may be only partially lacking. When the defect is partial, the upper end is found to be more frequently present, but any part may be defective. It may be represented by a mere fragment of the bone, or the greater portion of the shaft may be present, as in one of our cases. The ulna presents a rather constant finding. It is usually curved, short, and thick. At times it may be enormous in size, or it may be abnormally thin. The curvature is nearly always towards the radial side. In one case there was a doubling of the ulna with the radial surfaces in apposition. The ulna and the fragmentary or rudimentary radius may sometimes be in actual fusion, producing synostosis, which may occur when both bones of the forearm are apparently normal. Certain parts of the ulna, especially the olecranon, the tuberosity, and the styloid process, have also been found to be defective in some cases. The carpus is rarely complete. The scaphoid is the one most frequently absent, but it may be fused with a neighboring carpal bone. The semilunar is rarely absent, although a rudimentary form has been noted. The cuneiform and the pisiform are usually present, although their absence has been reported. The trapezium is the most frequently absent of all the bones of the second row of the carpus. Next to this is the trapezoid, which may often, however, be rudimentary or misshaped. The capitate and the uncinate are usually present, but their absence has also been observed. The metacarpal bones are usually free from deformity, except the first, which is often

absent, associated with the absence of the thumb. In one case only there was an apparently normal thumb with absence of the first metacarpal. There may even be a doubling of the first metacarpal bone. The phalanges are usually normal, except for those of the thumb which may be totally absent, or when present, there may be three, instead of two, phalanges. The distal phalanx of the thumb in one case was bifid. The phalanges may fuse with one another, constituting the skeletal basis for syndactylism.

The myology of the defective arm reveals interesting abnormalities. The pectoralis major may suffer from abnormal insertion or the pars abdominalis or pars clavicularis may be wanting. The pectoralis minor is usually normal. The deltoideus may have an abnormal insertion or its terminal fibres fused with those of the triceps or of the brachialis. The biceps brachii presents the greatest anomaly. When the radius is totally absent or when the upper portion is absent, the insertion of the muscle is into the lacertus fibrosus. In many cases, the biceps is found to be completely absent. It may at times be rudimentary or greatly hypertrophied; or it may be found to be fused with the brachialis, or with the coracobrachialis. In one case these three muscles were in union. The caput longum may be defective either by its total absence or by its abnormal origin, and the caput breve may be fused with the coracobrachialis, or may be entirely lost in the muscular mass of the forearm. The coracobrachialis usually presents no anomaly, but it may have an abnormal insertion or fused with the biceps as above stated. The brachialis is sometimes totally missing or rudimentary or atrophied. Guerin has described it fused with the lateral head of the triceps. The triceps is usually normal, but it may be atrophied or unusually stout. It sometimes fuses with the caput longum, or the latissimus dorsi, or the teres major. The anconeus is seldom absent but may often be rudimentary. The muscles of the forearm present the greatest difficulty in proper study of origins and insertions because of great irregularities due to the absence of the radius and of the interosseous membrane. The brachioradialis often presents a great anomaly. It is absent in nearly half of the cases. When present, it may be short and stout, may have a false origin as a continuation of the short head of the biceps or fused with the extensor carpi radialis longus, or it may be inserted into the ulna. The extensores carpi radialis longus and brevis are both very frequently absent or may be fused with the extensor digitorum communis, its tendon often being split into three portions which insert into the proximal phalanges of the fourth and fifth fingers and into the base of the third

metacarpal bone. The extensor digitorum communis may be fused with the two radial extensors or with the extensor digiti quinti proprius; often it is only partially present. The supinator is frequently absent. The extensor pollicis longus is absent in many cases or else fused with neighboring tissues. The extensor digiti indicis proprius fails in some cases or has an abnormal insertion. The pronator teres is often absent or is rudimentary, or fused with the brachialis or with the biceps, and may have an insertion into the ulna or upon the radial side of the carpus. The flexor carpi radialis fails in many cases. It may be found fused with the brachialis or with the palmaris longus, or it may be rudimentary. The palmaris longus is often defective, but well-developed cases are also on record; it may be fused with the superficial flexor. The flexor carpi ulnaris is usually normal and only exceptionally absent. It may be divided into two heads and its insertion may be varied. The flexor digitorum sublimis is usually present, but may often be atrophied or incomplete or it may be fused with the deep flexor. The portion which goes to the index finger is most frequently absent. The flexor digitorum profundus is less frequently abnormal than the superficial flexor, but may be defective, especially for the index finger, or may insert itself into the aponeurosis at the origin of the lumbricales. The flexor pollicis longus is almost always absent, although its presence or rudiment has been observed, or it may be fused with the deep flexor of the digits. The pronator quadratus is usually absent. It may exist as rudimentary muscle or may be inserted into the radial margin of the carpus or even into the second metacarpal bone. The abductor pollicis brevis, the opponens pollicis, the flexor pollicis brevis, and the adductor pollicis are very often absent, or, when present, may have anomalous insertions. The muscles of the little finger, the abductor, the flexor brevis, and the opponens digiti quinti, are usually normal. The lumbricales are usually normal but may sometimes be partially present. The same holds true with the interossei[14].

The blood supply of the affected extremity also reveals a few variations. The brachial artery is usually normal, but it may be divided into two branches at the middle of the upper arm. The arteria profunda brachii may come out of the arteria circumflexa humeri posterior. The ulnar artery is usually present, but it may be anomalous, concomitant with absence of the radial artery. The radial artery is very frequently absent (Herschel, Voigt, Geissendorfer) or markedly feeble, so that the failure to obtain the radial pulse at the usual site becomes one of the

diagnostic signs. The interosseous arteries are usually well-developed and may take the place of the radial and ulnar arteries.

The neurology of the defective arm shows certain abnormalities. The brachial plexus reveals almost no pathology, nor do the nerves in the upper arm. Garipuy, however, reports a case of plexus atrophy. In the forearm, the median and ulnar nerves are almost always present, but their distribution with reference to the muscles may be anomalous. The ulnar nerve may be thin and terminate abruptly at the elbow, or it may be totally absent as in the case reported by Dedru. The median nerve may be bifurcated abnormally and may supply the muscles ordinarily innervated by the ulnar nerve when the latter is absent, and the distal distribution of the radial nerve, which is often absent. The radial nerve, in great majority of cases, terminates at the elbow, and it may fail altogether, its terminal distribution being supplied by the hypertrophied ulnar nerve, or more frequently by the median nerve. The musculo-cutaneous nerve is very frequently missing, its place being taken by the median.

True to the Virchow-Rokitansky law of congenital anomalies, the patients with either total or partial absence of the radius usually show some associated pathology. The details in the main have been already mentioned in Table I. The most common concomitants are the various varieties of club-foot, unilateral or bilateral. Such malformations as atresia ani, hare-lip and cleft palate, hydrocephalus internus, umbilical and inguinal hernia, atresia urethrae et vesicae urinaris, kyphosis and scoliosis, luxation and weakness of joints, and congenital torticollis are rather common occurrences. Other occasional associations are anencephalus, pseudocephalus, the deformed mandible, absence of one or both eyes, absence of the nasal septum and of the interventricular septum of the heart, strabismus, tracheo-oesophageal fistulae, spina bifida, deformed ribs, absence of the auricles and external auditory canals, hemiatrophy of the face, and various genital defects, such as hypospadias and cryptorchism.

ETIOLOGIC CONSIDERATIONS.

The etiology of congenital absence of the radius is more or less theoretical, as experimental production of the deformity has not as yet been attempted[15]. Kümmel distinguishes the dynamic or endogenous and the mechanical or exogenous causes. It is impossible to classify the various theories proposed because of the difference in the standpoint.

We may briefly summarize the more important theories as expounded by previous workers.

(1) The most interesting is the archipterygeal theory of Gegenbaur[16]. This theory assumes that the origin of the skeletal system of vertebrate limbs is in primitive fin rays (Flossenskelett or archipterygium) of the Dipnoan fish. According to this view, the upper extremity consists of the main stem (Hauptstrahl) and four accessory rays (Nebenstrahlen). To the main stem belong the humerus, the ulna, the two ulnar carpal bones, the fifth metacarpal, and the three phalanges of the fifth digit. The first accessory ray comprises the radius, the scaphoid, the trapezium, the first metacarpal, and the two phalanges of the thumb. The index finger, the middle finger, and the ring finger, with their metacarpal bones and the middle portion of the carpus, consititute the second, third, and fourth accessory rays respectively. This view assumes also that the bony defect is always a suppression in regular order from above downwards of one or more rays. Applying this theory to the causation of the deformity, Herschel[17] remarks: (1) All hitherto observed cases are regarded as reduction of the first ray, and (2) all cases with the presence of distal segment of the first ray are not to be regarded as cases of pure radial defect but as those of coalescence (Verschmelzung) of the two bones of the forearm. This latter view appears to be particularly fitting in explaining the cases in which the thumb and its metacarpal are well-developed, while the radius is defective in its entire length.

(2) The mechanical theory of compression during the intra-uterine life has the greatest number of followers. This theory was first developed by Dareste[18], in 1882, although Hippocrates and later Paré, Cruveilhier and Saint-Hilaire had previousy expounded, and ardently advocated by Kirmisson, Ahlfeld and many others. In his important communication, Dareste says, "Mes recherches sur la production artificielle des monstruosités, m'ont appris que, dans l'embryon des oiseaux, un grand nombre de monstruosités simples résultant de la compression partielle du corps de l'embryon; que l'agent de cette compression partielle est l'amnios arrêté dans son développement; enfin, que cette compression partielle ne peut déterminer d'événements tératologiques qu'autant qu'elle s'exerce de très bonne heure, lorsque l'embryon n'est constitué que par des celles homogènes et ne présente pas encore des éléments histologiques définitifs." Thus the theory in brief rests on the conception that the amniotic fluid exerts an important influence by its pressure upon different parts of the fetal ovoid, producing either complete or partial absence of the bone according to the degree of its pressure. Thus

Kümmel considers the defect as a form of arrested development of exogenous nature, through either of the three factors: (1) space-shrinkage in otherwise normal uterus, (2) spherical chorionic sac and fetal body and adnexa exerting pressure upon one another, or (3) abnormal and diseased amniotic fluid. This theory has aroused much discussion, for, although it has many evidences in its favor, it cannot explain why and how the defect is so regular and bilateral in most cases, or what is the mechanism of supernumerary digits and many other concomitant defects[19].

(3) Another interesting theory is that of the nervous influence upon the growth and development of the bone. The observation made by Serres, Tiedemann and Troisier reveals the fact that in certain cases of thoracic ectromelia there was a definite absence of cervical enlargement in the spinal cord. Broca, in examining the neck of an adult with bithoracic ectromelia, found that on each hemisphere of the cerebrum there was a very pronounced atrophy in the region of the ascending frontal convolutions. Schmid[20] thinks that in certain deformities, there are certain developmental disturbances in the central nervous system, corresponding to the side and location of the deformity. Bouvier also remarks that "it is very probable that in certain monsters with more or less deep cerebral lesions, the club-hand is equally due to the morbid influence of the nervous system upon the muscles." Dareste, however, thinks that the atrophy of the brain and cord is a consequence rather than a cause of malformations, for the development of the nervous system, like that of the vascular system, depends upon the organs to which it sends its innervation or the blood.

(4) The most interesting theory, however, is that of Virchow who thinks that it is an inflammatory process which acts as a causative factor in producing malformations. His statement is brief but effective. "We can scarcely doubt that the chief aspect of every cycle of this disturbance is only a smaller part which has been altered through irritative and inflammatory (active) process, and that the defective (passive) condition of the majority of cases show only the results of this active process. . . . We are dealing, then, as in so many monsters, with very early multiple irritations or inflammations, if you will, with a phlogistic diathesis."[21] This view has a definitely rational basis, for it is well known that an inflammatory process does cause a disturbance in a growing organism.

(5) Allied to this view is the theory that certain disease conditions are responsible for the production of deformities. Rickets has been

suggested by Houel, while syphilis is thought to be etiologic by Peterson, Secord, and Cuff. Burckhardt has proved, with the aid of numerous observations, that traumatism in one form or another incurred during pregnancy was the only ascertainable etiologic factor. It is further observed by McCurdy that certain mental diseases or emotional disturbance may be considered causative. The list would be almost endless, as there may be mentioned many other conditions which may have existed during pregnancy, either maternal or fetal. These conditions, however, can not be held as absolutely responsible for the production of defects.

(6) A few authors have noted certain familial or hereditary tendencies in some cases. Bouvier records occurrence of congenital clubhand with absence of the radius in a father and four out of his five children who had the same deformity. Blencke described a case in which this defect occurred in the first, second, seventh, and ninth children of a family. Joachimsthal records six members of a family (the mother and five children) with similar deformity, although he inclines to believe that this may have been primarily due to the abnormal influence of amnion. These facts are exceptional rather than usual.

Among the minor theories are: (7) the theory of muscle retraction, due either to abnormal tonicity or to actual shortening and contracture, causing the uneven balance of pressure, and (8) the theory of insufficient ossification of the bones concerned.

After all the theories have been enumerated, it is still an open question whether any single theory can be accepted as adequately explaining the cause or causes of congenital absence of the radius. Each theory contains some element of truth and hence we can not reject any one of them *in toto*. We have found evidences that more than one single factor is at work in producing the train of deformities in a given case, and, therefore, it is necessary that we interpret it as a product of a variety of causes in intra-uterine life.

Embryology teaches us that the shaft of the radius begins as a cartilaginous segment in the mass of mesenchymatous tissues known as the axial blastema in the fifth week of fetal life. The process of ossification gradually progresses throughout gestation until at birth the shaft is usually a well-formed bone, the two ends being capped with cartilaginous tuberosities, although the secondary center of the distal epiphysis does not appear until the second or even the third year of post-natal life and that of the head of the bone not until the fifth to the seventh year.

The absence of this bone, therefore, means that there has been intro-

duced some retrograde or suppressive influence upon this primary center of ossification, which must have originated during the very first few weeks of embryonic development. At this stage, the fetus is so diminutive that it is difficult to conceive of any exogenous influence, either due to the shrinkage of intra-uterine space or to oligamnion, exerting energy sufficient to bring about the disturbing force specifically upon the ossifying shaft of this bone. It seems more probable that the essential factor at work in producing the defect lies in some germinal vagary inherent in the osteogenetic mesoderm of the limb buds. This is especially persuasive when it is recalled that the deformity is very frequently bilateral and that this deformity is usually associated with some concomitant anomalies, which go to prove that somewhere in the early state of cellular proliferation, some perverse influence has set in which not only involves the specific osteogenetic cells for the radial ray, but also other portions of germinal epithelium destined to form the *anlagen* of other organs. Whether or not this disturbing force is the result of some disease or inflammatory condition (Virchow's phlogistic diathesis) needs further study. It is, however, well known that inflammatory processes are always accompanied by some suppressing effects upon the growing organism. It is readily conceivable that a given metamere or myotome, or even a given portion of the mesoblastic tissue, may suffer an inflammatory effect of irritation, either maternal or fetal in origin. It is, however, more probable to think that the condition is brought about by certain inherent reversion of embryonic cells, including both the cytoplasm and the nucleus with its chromosome bodies, coupled with some retrogressive changes in tissue metabolism, so that, in fine, the process of deformity production may be regarded as a variety of pre-formative disturbance or cellular dystrophy of a given group of germinal cells at the very inception of fetal life. This cellular dystrophy may be the result of various influences, such as maternal and fetal inflammation, inherent cell pathology, vagaries of the chromosome material, defective cytoplasm, trophic nerve disturbance, or abnormal blood supply. Although the conception above set forth may not go very far in truly explaining the production of the deformity in question, yet it at least furnishes us with a point of view which may be further elaborated in formulating an adequate theory of causation.

DIAGNOSIS AND PROGNOSIS.

The diagnosis of congenital absence of the radius is usually not difficult, as the pathology produces a symptom-complex which consists

of the following well-marked aspects on examination: (1) the atrophy of the affected extremity, especially of the forearm; (2) the hypertrophied and curved ulna, the convexity of curvature being on the posterior side; (3) the radio-palmar club-hand, the hand often bent at a right angle, or even touching the radial border of the forearm; (4) the thumb on the affected side, together with its metacarpal bone, is frequently absent, or at least rudimentary and defective; (5) the presence of other evidences, of congenital malformation, especially supernumerary fingers and toes, or syndactylism. In many cases the diagnosis may be conclusive by palpation alone, but its ultimate confirmation must depend upon the roentgenologic findings. This is especially true in cases of partial absence of the bone, as the absence of the head or the proximal portion of the shaft usually produces an apparently normal conformation. The radio-palmar variety of club-hand is usually associated with either the defect of the distal end of the bone or its complete absence. In some cases it may be necessary to test the function of the radial nerve, such as the voluntary control of the muscles innervated by it, or the electrical stimulation of these muscles. The transposition of the radial artery or even its absence often aids in diagnosis. Congenital absence of the radius is differentiated from acquired defect mainly on the history of previous illness, namely, osteomyelitis and tuberculosis of the radius.

The prognosis of the radial deformity is a serious matter, due primarily to the associated pathology, combined with greatly reduced power of resistance, which in some cases are so marked as to render life impossible; many of the unfortunate patients die young, while we may find them as old as 30, 50, and even 70 years. The great majority of cases succumb to some intercurrent infections of childhood. In cases where the radial deformity is not associated with other pathology, the outlook as to life is good. The correction of the deformity itself depends upon the degree of pathology. When the defect is confined to the upper part of the bone, the treatment is most effective, while the cases of complete absence offer a gloomy outlook. Various operative measures have been advanced and the deformity has been controlled to a greater or less extent, but the final result is never completely satisfactory. The surgeon as well as the patient must be content if, by means of operative interference, the unsightly malposition of the hand, which in many cases is so extreme as to make the affected extremity almost useless, can be remedied to a reasonably serviceable degree. At least the deformed hand will always be weak and the affected extremity always atrophied.

PROPOSED METHODS OF TREATMENT.

As to the treatment of this deformity, the consensus of opinion seems to be that of pessimism. Walter Pye pronounces this condition as not amenable to treatment[22], the same sentiment being shared by many others. In all cases, non-operative measures should precede operative interference. The deformity is usually brought to the attention of physicians quite early in the patient's life, and in every case massage and manipulation combined with immobilization must be tried. The simplest immobilization apparatus is a plaster bandage, but elaborate devices have also been tried, such as that used by Robert and Collin[23].

The operative methods may be summarized as follows:

(1) Tenotomy of contracted muscles, such as the flexors and the adductors, combined with division of resistant tissues causing the deformity, is the simplest operation. This, however, is impracticable in most cases, as the muscles are ill-developed and the hypertrophied and curved ulna defeats the purpose of the operation.

(2) Arthrodesis of the ulno-carpal joint, which aims at the fixation of the wrist, is practicable only in a limited number of cases.

(3) Hoffa's method of simple osteotomy of the ulna, followed by overcorrection of the hand, was successfully performed in a child a few months old (Fig. 7, A). This is sometimes combined with tenotomy of tendons of resistant muscles.

(4) Romano[24] did a cuneiform osteotomy, removing a trapezoid segment from the lower end of the ulna, and suturing the carpal bone to the ulna with a wire, combined with the incision of the muscle and fascia and the hand was put up in Depuytren's position (Fig. 7, B).

(5) Sayre[25] did osteotomy of the ulna and followed it by stretching the contracted tissue on the radial side by means of adhesive plaster. Several weeks afterwards, he resected the os magnum and the uncinate, and into the gap thus made, he inserted the lower end of the ulna, which was sharpened somewhat by removing the styloid process. Roswell Park's method is similarly that of first removing two bones of the first row of the carpus and fastening the sharpened ulna into it with kangaroo tendon. The first metacarpal bone was transplanted in position from the humerus of a rabbit, and the arm was fixed in perfect extension (Fig. 7, C-D).

(6) Bardenheuer[26] demonstrated in 1894 a new method of treating the deformity by splitting the distal end of the ulna into a radial and an ulnar portion, and a carpal bone is allowed to slide up between the

separated ends in order to keep them apart, fastening the ends to the carpal bones on each side by means of an ivory peg. Tubby[27] has stitched the parts in place with silk-worm gut. A plaster bandage was applied and left for four weeks (Fig. 7 G).

(7) McCurdy[28] found Bardenheuer's method impracticable on account of great shortening of the soft structures, and performed his operation by first severing the ulna at a point where the free end of the upper fragment could be brought to the semilunar, which was curetted, and the two bones adjusted by silk-worm gut. Then he did tenotomy of tendons on the radial side and the arm was put up in a plaster cast (Fig. 7, E-F).

(8) Antonelli[29] argues that any injury to the carpal bones or section of the atrophied muscle tendons is undesirable because of subsequent fixation and resulting limitation of function, and proposes two methods as follows: (1) Longitudinal splitting of the ulna from the distal to near its cubital end, with the idea of producing a new radius, which is held in place by interposing the neighboring muscles. The middle third of the ulna is then broken obliquely by manipulation and the end of the newly-made radius is attached to the ulna and the carpus by means of wire; (2) longitudinal splitting of the ulna as before, fixing the new radio-ulno-carpal articulation as already described and plastic lengthening of tendons by Z-shaped method (Fig. 7, H-I).

(9) Albee[30] has done a successful bone transplantation in a patient with club-hand due to radial defect, where a tibial graft was mortised into the ulna at about its middle, and the lower end inserted into properly prepared orifices in the carpus (Fig. 7, J).

(10) Finally a new operative procedure has been devised by Dr. Edwin W. Ryerson in one of our cases herein reported. He removed a bone graft from the posterior surface of the ulna and implanted it in the place where the radius normally is, deep beneath the extensors of the hand, suturing the muscles and fascia over the newly-formed radius. In removing the graft, it is important to note that the periosteal covering as well as a portion of the distal epiphyseal cartilage are carefully left attached to the graft with the view of aiding in the preservation of osseous tissues after transplantation. After the skin wound is sutured, the arm is put up in extension with a plaster bandage (Fig. 7, K-L). This method may be said to be satisfactory in aiding the correction of the deformity, providing the absorption of the graft be prevented.

SUMMARY AND CONCLUSIONS.

(1) Congenital absence of the radius is by no means a rare condition, there being at least 250 cases recorded in medical literature up to 1923. These cases are reviewed and tabulated, together with three cases here reported.

(2) The principal pathlogy of the radial defect comprises: total or partial absence of the radius, either unilateral or bilateral; the hypertrophied and curved ulna on the affected side; congenital club-hand, usually radio-palmar in type; absence of the thumb, together with its metacarpal bone; general atrophy of the affected extremity; and the limitation of joint movements.

(3) The radial defect usually is associated with other concomitant anomalies elsewhere in the body.

(4) There are many theories proposed to explain the etiology of this deformity. Of these, Gegenbaur's archipterygeal theory and Dareste's amniotic theory have the largest number of followers. The present writer believes what the essential cause of the defect is due to some disturbing factor which arises during the first few weeks of fetal life, either due to the inherent defect in cell vitality or to some inflammatory or irritative process (Virchow's phlogistic diathesis).

(5) Diagnosis of the condition is usually not difficult, but the ultimate verification must rest in radiographic findings. Prognosis is always grave, as the degree of anomalies may be so extensive as to make life impossible, or at least the power of resistance so weak as to make the patient succumb to some intercurrent infection. The operative measures merely correct the deformed hand, but the affected extremity always remains weak.

(6) The various methods of operative procedure have been devised and these are reviewed briefly. The Ryerson method of ulnar graft, as adopted in one of our cases, is also mentioned.

To Dr. Edwin W. Ryerson, Attending Orthopaedic Surgeon, in whose service the three cases herein reported were first seen and treated, and who kindly gave me the permission to report the cases and the encouragement to complete the study of the subject, I wish to acknowledge my indebtedness.

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A COMPARATIVE STUDY OF THE RELATIVE VALUE OF VARIOUS SURGICAL PROCEDURES IN THE TREATMENT OF INFANTILE PARALYSIS OF THE LOWER EXTREMITY.

BY JAMES E. M. THOMSON, A.B., M.D., LINCOLN, NEBRASKA.

Since the epidemic of 1909 and the subsequent milder epidemics of infantile paralysis, this vicinity has offered a splendid opportunity for its study. From time to time reports of the progress made have appeared in the literature through the efforts principally of Dr. H. Winnett Orr and Dr. J. P. Lord. A rather complete preliminary report was offered as early as 1911. Later there was a report of one hundred patients who had had infantile paralysis for five and one-half years.

One of the objects of this paper is to bring out the present status of many of these cases, and by them and others to show the comparative value and efficiency of bony operations to soft tissue operations for the improvement of function and stabilization of the lower extremity.

A review of the recent literature on this subject reveals, to quote Dr. Lovett[1], that it "is confused and befogged." The pendulum has swung to and fro many times since Nicoladoni in 1881 described his technique for tendon transplantations, and since Dr. Whitman[2] in 1897 recommended astragalectomy in the treatment of infantile paralysis. However, my review has been limited to a great extent to the literature of the past eighteen years, and the trend of enthusiasm over various operative procedures during that time is interesting.

Dana and Townsend[3], of Boston, in 1904 concluded that tendon transplantation for the equalization of muscular balance was a failure so far as the lower leg was concerned, and that arthrodesis of the ankle and astragalectomy uniformly offer greater promise of obtaining a useful foot. At about the same time Professor Hoffa[4] of Berlin recommended the Lange periosteal transplantation, as did Mr. Tubby[5] of London (1906). The same year Dr. Lorenz[6] of Vienna opposed transplantations of the flexors of the knee into the quadriceps. In the year following, Lange[7] (1907) described his spectacular vastus externus substitution for paralyzed glutei with sublimated silk retention. In the

same year Herz[8] definitely decided that the silk ligaments of Lange and Reiner for fixation of joints were failures.

It was not until 1908 that Sir Robert Jones[9] recommended his two stage "V" shaped tarsotomy as an alternative for the Whitman operation. In an article entitled "Arthrodesis and Tendon Transplantation" he advised arthrodesis in a case of complete paralysis, and tendon transplantation whenever partial paralysis existed. At about the same time Dr. Goldthwait[10] described his technique for arthrodesis of the ankle. With Dr. Flexner's[11] discoveries in regard to the etiology of infantile paralysis, much was written on this subject and on the acute symptoms and early treatment. In the years immediately following, 1908 and 1909, there were many articles in Europe and America regarding tendon and bony operations for improving stabilization. Nicoletti[12] in Rome went so far as to arthrodese his patient's hip and ankle, with such splendid results that arthrodesis of the knee was even contemplated.

During the period just preceding the world war, Dr. R. E. Soule[13] recommended arthrodesis of the astragloscaphoid and calcaneoscaphoid joints, at about the same time as Dr. Davis[14] offered his subastragalar arthrodesis. Also Dr. W. E. Gallie[15] described his technique for tendon fixation, and Dr. DeForest Willard[16] emphasized the importance of joint fixation. During the war the orthopaedic literature was confined almost exclusively to the problems involving the care of war casualties. But shortly after, surgical treatment of infantile paralysis came again into prominence. In 1919, Major Naughton Dunn[17] described his wedge shaped tarsotomies and transplantation operations of the posterior tendons into the tendo Achillis and os calcis for calcaneo cavus. A year later he attributed the failures in tendon transplantation to faulty selections of tendons for transplantation and to lack of proper re-education. Dr. A. M. Berstein[18] described his technique for transfer of the tendon sheaths with the tendon transplanted. Shortly thereafter, Dr. Royal Whitman[19] introduced his "loop operation" for paralytic equino varus, which operation a year later was strongly advocated by Dr. Kleinberg[20] for this deformity. The results of Dr. Sever[21] in his report of one hundred fifty-nine patients on whom astragalectomy was performed on two hundred and seventeen feet, called forth critical comment later by Dr. Whitman. Dr. Lovett in his lecture on "Operative Treatment of Infantile Paralysis" for the Mayo foundation, reviewed the various operative methods with their advantages. Dr. Steindler[22] described his "stripping of the os calcis" in preference to the ordinary plantar fasciotomy. The report of the Commission, appointed by the

American Orthopedic Association, on stabilizing procedures on the foot, prepared by Dr. Ansel G. Cook[23] and Dr. Walter G. Stern[24], advocated bony operations. Strong points are brought out in favor of Dr. Davis's "sub-astragaloid arthrodesis" and "transverse horizontal section," along with Dr. Ryerson's "triple arthrodesis," and astragalectomy with backward displacement of the foot, performed after the method of Dr. Royal Whitman. Due credit is given the recent papers of Drs. Whitman, Gill, and Willard. Directly following this publication of the Stabilization Commission reported at the same meeting of the American Orthopedic Association, was the paper by Dr. Michael Hoke[25], describing his method of stabilizing the paralytic foot. This operation indeed gives splendid results, and offers distinct advantages in the treatment of various deformities of the foot, by the re-implantation procedure of the head of the astragalus and the osteotomy of the tibia. At the time this appeared, an article by Dr. A. Bruce Gill[26] furnishing the end results of a large series of carefully managed operative procedures for infantile paralysis was published. In this series two-thirds of the tendon transplantations were failures, and he emphasizes the difficulty in obtaining lateral balance once it has been disturbed. He is an advocate of astragaloscaphoid arthrodesis, combined with the Whitman loop operation, and has had relatively good results from the bony operations. He recommends osteotomy of the femur in older children and has had better success from the transplantation of the sartorius into the patella than from transplantation of the biceps or semimembranosus.

The recent concerted stand in favor of operations on bones as stabilizing procedures in preference to soft tissue operations, except as combined with bony operations, has been sufficient to warrant this careful study of our own work in order to determine whether our experience corroborates the findings of recent writers, and to crystalize the information into definite figures in such a way that the relative value of one type of operation may be combined with another.

This study is based upon the observation and records of patients treated in the Nebraska Orthopedic Hospital and in the private hospital services of Dr. H. Winnett Orr and the writer. Patients at the Nebraska Orthopedic Hospital have been operated upon usually by Dr. J. P. Lord and Dr. H. W. Orr. There have been, however, at various times on duty in that institution and associated in the surgical treatment or care of these patients the following: Drs. E. C. Henry, A. I. McKinnon, H. E. Flansburg, W. A. Crutcher, B. A. Finkle, and the writer.

This is not a selected group of surgical cases, but rather a consecutive series of one hundred forty-four individuals affected with infantile paralysis involving one or both extremities. These have been arranged for study in alphabetical order in chart form. The first column of the chart gives the number and name of the patient, the second, the extremity or extremities affected and the nature, in brief, of the deformity. In some instances this was not sufficiently described in the case record, and therefore omitted in this column. Not but that the character of the deformity was apparent from the operations performed, but it was omitted because every effort has been made to confine this study accurately to the case records and supplementary inquiries, questionnaires, surgeon's and attending physician's reports, and personal observations of the patients themselves. The next column gives the dates of operations. It is interesting to note that one hundred and ten of these patients had but one operative appointment. Twenty-six were operated upon twice, eight patients had three operations, and four were operated upon four times. One patient had five operations, and another six operations. In the third column the operations performed in each case are enumerated. The next column shows by the letters (C) and (B) whether casts, braces, or both were used in the after treatment, (C) indicating casts, (B) braces. The next column headed (REPLY) indicates by the letters (R), recent replies to inquiries, (S) surgeons' and attending physicians' reports, and (O) observation of the patients. The column headed (TIME) shows the number of years since the operation was performed.

The following column of figures represents my method of grading results by percentages and deserves considerable explanation. In a review of several articles, describing at least in part the successes and failures in the surgical treatment of infantile paralysis, the percentages given are in such variance, and the terms in which their results are expressed are so diversified that no comprehensive deductions could be made for a comparative study of the various operations on the lower extremities. Therefore, in this paper an effort has been made to follow a definite system of grading, adaptable to all operations on the lower extremity, with particular reference to the practicability of the operation not only from the operators' standpoint, but from the standpoint of the welfare of the patient. It is indeed safe to assume that the purpose of an orthopaedic operation is to—

1. Correct the deformity.
2. Improve function.

3. Add to the comfort of the patient.

4. Reduce the amount of appliances (braces and splints) necessary, or to render apparatus wearable which was previously inapplicable on account of the deformity.

Unless operative intervention accomplishes to some extent all of these four purposes it is useless, dangerous, and inadvisable. In order to determine what our own results have been, and to what extent we are fulfilling the purposes of the surgical treatment of infantile paralysis, an effort has been made to grade each patient on the individual merits of each case, as to the ultimate extent of the correction of deformity, improvement of function, added comfort to the patient, and the extent to which apparatus has been reduced, or made more applicable. Therefore, on the basis of 100 per cent. for a perfect result, each case has been graded: that is, 25 per cent. for absolute correction of the deformity, 25 per cent. for perfect return of function, 25 per cent. for complete comfort to the patient, and 25 per cent. for the absence of previously necessary apparatus, or for the ability to stand and walk with the easiest type of brace or apparatus which was, due to contractures and deformities, impossible before the operation was performed.

On account of the fact that many of these patients have had surgery on both extremities, it has been necessary to classify the right and the left separately, because of the differences in operative procedures and the variation in the results obtained. Further, since there are patients on whom operations have been performed on or about the knee and thigh, as well as the foot, and since the results,—for example, from stabilization of the foot,—have averaged 98 per cent., yet the results from the knee operations of the same extremity have totaled only 65 per cent., it is deemed necessary to grade these separately as well as collectively in order to obtain adequate and fair gradings for the operative ventures about the foot as well as for those about the knee and thigh, and their relative bearing to each other. Likewise by the addition of these percentages the total value of the combined procedures can be calculated.

In each case where several operations have been performed, the case has been classified under "*The Operation of Principal Factor*" in relation to its ultimate effect on the ankle and foot, knee and thigh. For instance if a patient had an arthrodesis of the ankle with tendon transplantation or fixation, the arthrodesis is considered the "*Operation of Principal Factor,*" and the case graded under that heading. Therefore charts have

been prepared with summary averages on each of these operations of principal factor. Those about the foot are—

1. Arthrodesis of the Ankle.
2. Astragalectomy.
3. Tendon Transplantation and Silk Ligaments.
4. Minor foot operations (Lengthening of Tendo Achillis, plantar fasciotomy, tenotomies of the foot, and forcible correction).

Those operations about the knee are—

1. Transplantations of the hamstrings to quadriceps.
2. Lengthening of hamstrings.
3. Supracondylar osteotomy.
4. Arthrodesis of the knee.

Operations of the thigh are—

1. Soutter (implying the operation described previously).
2. Fasciotomy of the fascia lata.
3. Davis fascia lata operation.

ARTHRODESIS OF THE ANKLE.

Refer to Summary Chart.

The term arthrodesis of the ankle implies—

1. The approach of the tarsus by means of the Kocher incision below and behind the external malleolus, or by an incision down the dorsum of the ankle, retracting the tendons and soft structures. In each case the articulating surfaces of the tibia and fibula are stripped entirely of their cartilage, and likewise the astragalus is denuded entirely of its cartilage, as well as the opposing surfaces of the os calcis, scaphoid, and cuboid. The foot is displaced backward and set in a corrected position. If necessary a nail is driven through the os calcis and astragalus into the tibia, to be withdrawn in the course of ten or fifteen days.

2. The panastragaloid arthrodesis as taught by Dr. Arthur Steindler, which is similar in many respects to the previously described procedure.

3. The transverse horizontal section and subastragalar arthrodesis described by Dr. G. G. Davis.

The average number of years since these operations were performed, is 3.8 years. There are thirty-nine patients in this series, on whom forty-seven arthrodeses of the ankle were performed. Eight of the patients had arthrodesis performed on both ankles. We quite agree with Dr. Hoke[25] in his qualifications for successfully operated feet. To

quote his exact words—"1. They must look natural in shoes. 2. They must be so stable that they do not turn laterally on the long axis of the foot when the patient is standing or walking. 3. They must be so stable in the natural or nearly natural attitude that they do not need braces to hold them so. 4. When bare-footed they must look natural, or if that is impossible, nearly enough so as to present no gross deformity." On this basis we have graded these operations, following the general requirements for operations of this nature.

1. As to the extent of correction of deformity.
2. As to the improvement of function.
3. In regard to the additional comfort given the patient by the operation.
4. The decrease in apparatus necessary for weight bearing and walking.

The average improvement for the entire series was: correction of deformity, 20.2 per cent.; improvement of function, 19.5 per cent.; additional comfort of the patient, 21.9 per cent.; and decrease of apparatus necessary 22.6 per cent.; giving a total of 84.2 per cent. Included in this series of percentages are seven arthrodeses that were performed less than a year ago, where the deformity has been well corrected, but on account of the short period of time since operation, the grade for apparatus used is relatively low, making a total average of only 73 per cent. Without these seven operations performed but a short time ago, the total for the remainder would be raised at least 2 per cent. After studying the relative merits of this operation we feel that to return the foot to within 16 per cent. of normal by one of the previously described methods of arthrodesis, qualifies this operation as a dependable procedure for stabilizing paralytic lateral deviations of the foot. A further study of the summary chart shows that there is a slightly higher percentage for arthrodesis combined with other foot operations, such as tenotomies, tendon transplantations, and tendon fixations. Particularly has there been a diminution in the amount of apparatus used. This is especially true when arthrodesis is combined with tendon fixations. The total percentage for the combined operations is 88.6 per cent., which is 4.6 per cent. higher than for arthrodesis performed alone.

One of the arthrodeses given in this series was performed after a Whitman operation failed to give a satisfactory result. Two subastragaloid arthrodeses were failures, and one of these after a second attempt gave splendid results. The other by a Whitman procedure became satisfactory.

SUMMARY CHART.

ARTHRODESES OF THE ANKLE.

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
No. of patients in this series.....	39					
No. of patients in this series who within the last ninety days have						
Replied to inquiries Surgeons' Reports.....						
Are under observation.....	33					
No. of Arthrodeses performed....	47	20.2	19.5	21.9	22.6	84.2
No. of Arthrodeses performed alone—A.....	33	20.2	19.6	21.6	22.9	84
No. of Arthrodeses performed with other foot operations—B	14	20.1	19.5	23.5	23.3	86.5
No. of Arthrodeses performed by Davis.....	8	20.1	19.4	21.6	22.3	83.4
No. of Arthrodeses performed with other operations on the leg	8	20.5	20	21.5	21.3	83.3
No. of Arthrodeses performed within the last year.....	7	20.6	18.4	19.4	16.9	75.3
Foot Operations Performed with Arthrodeses.						
Tenotomies and Lengthenings.....						
Plantar Fasciotomy.....	4					
Forcible Correction.....	2					
Lengthening of Tendo Achillis.....	4					
Tenotomies of Foot.....	1					
Average.....		18.1	18.5	22.7	25	84.3
Tendon Transplantations and Fixations.						
Transfer of Extensor Longus Hallucis.....	2					
Peroneus Longus and Tibialis Post. to						
Tendo Achillis.....	2					
Tendon Transplantation (Multiple).....	3					
Fixation of Tibialis Anticus..	7					
Fixation of Tibialis Posticus.	2					
Fixation of Peroneus Longus.	2					
Average.....		20.8	20.6	24.2	23.2	88.6

Average No. of years since operation was performed 3.8

Our experience with the Davis subastragaloid arthrodesis and horizontal transverse section is slightly less satisfactory than with other methods of arthrodesis (83.4 per cent.). Particularly in regard to the correction of deformity (20.1 per cent.), and improvement of function (19.4 per cent.).

Those patients having arthrodeses, on whom other operations were performed on the leg and thigh, had a somewhat lower general average (83.3 per cent.). However, so far as the correction (20.5 per cent.) of deformity and function (20 per cent.) is concerned, they were relatively higher, but on account of the more extensive paralysis as evidenced by the fact that leg operations are necessary, the comfort of the patient was less improved (21.5 per cent.), and there was not the decrease of apparatus (21.3 per cent.).

ASTRAGALECTOMY.

Refer to Summary Chart.

For astragalectomy the technique described by Dr. Royal Whitman was ordinarily used, except in a very few instances in which the operations were modified to meet the requirements of some particular deformity. If the displacement of the foot backwards was difficult, nail fixation was used as described in the paragraph on arthrodesis of the ankle.

This series embodies forty cases in which forty-three astragalectomies were performed. The average number of years since operation is 4.9 years. On three of these patients astragalectomies were performed on both feet. The grade percentages of this series of cases vary but little with those of arthrodesis of the ankle, the average being, for correction of deformity 20.8 per cent.; improvement of function 19.3 per cent.; added comfort to the patient 22.1 per cent.; less apparatus 22.2 per cent. This gives a total of 84 per cent., which is two-tenths of one per cent. below the total for arthrodeses of the ankle (84.2 per cent.). We believe this is indeed a fair comparison, since there are nearly an equal number of operations in each series. Of forty-three operations, five were performed less than a year ago, with a relatively low general average (71.8 per cent.),—in fact, even lower than the percentage for the recent arthrodeses of the ankle (73 per cent.). Here again, due to the fact that the patients are wearing braces (13.6 per cent.) and the function is materially lower (16.8 per cent.), we can account for this decreased general average. A study of the individual cases reveals the fact that as years increase since astragalectomy was performed the general average becomes gradually higher up to the sixth year, particularly in regard to function and comfort to the patient.

SUMMARY CHART.

ASTRAGALECTOMY (WHITMAN).

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
No. of patients in this series....	40					
No. of patients in this series who within the last ninety days have Replied to inquiries.....						
Surgeons' Reports.....						
Are under observation.....	35					
No. of Astragalectomies performed.....	43	20.8	19.3	22.1	22.2	84
No. of Astragalectomies performed alone—A.....	25	20.8	20.6	22.9	23.3	87
No. of Astragalectomies performed with other foot operations—B.....	18	20.8	17.9	21.2	21.2	81
No. of Astragalectomies performed with other operation on the leg.....	11	21.2	19.1	22	20.8	83.1
No. of Astragalectomies performed less than 1 year.....	5	21	16.8	20.5	13.6	71.8
Foot operations performed with Astragalectomy--B						
Tenotomies and Lengthenings.....						
Plantar Fasciotomy.....	3					
Tenotomies of Foot.....	2					
Length. Tendo Achillis.....	7					
Forcible Correction.....	3					
Average.....		19.4	17.1	21	20.3	78
Tendon Transplantations and Fixations performed with Astragalectomy.						
Tib. Anticus Fixation.....	4					
Jones Loop Suspension.....	1					
Peroneus Longus and Tib. Post. to Tendo Achillis...	2					
Tendon Transplantation (multiple) Average		21.6	19.7	22.2	23.1	86

Average No. of years since operation 4.9

Twenty-five of these astragalectomies were performed alone, the total percentage being 6 per cent. higher than those astragalectomies performed with other foot operations. It is noteworthy that among those astragalectomies combined with other foot operations, the percentage for fasciotomies, tenotomies, and tendon lengthenings is extremely lower (78 per cent.), while those combined with tendon transplantations and fixations resulted in a much higher grade (86.6 per cent.). In the first instance the operation is primarily for correction of deformity, while in the second the tendon changes may aid in maintaining the corrected position of the foot. Of those astragalectomies performed with operations about the knee and thigh there are eleven. Due to the more extensive paralysis, the general average of these operations is somewhat lowered. In our experience this operation is particularly advantageous in calcaneus deformities, flail feet, and certain persistent equinus deformities.

MINOR OPERATIONS ON THE FOOT.

Refer to Summary Chart.

(Lengthening of tendo Achillis, plantar fasciotomy, tenotomies of the foot, forcible correction, etc.)

This group combines various minor operations on the foot and ankle that are of a similar nature. Lengthening of the tendo Achillis was performed by the open subcutaneous zigzag method, or by plastic lengthening. By tenotomies of the foot is meant the division of various soft structures about the foot and ankle for the correction of deformity without enumerating the structures sectioned. Plantar fasciotomy implies the open or subcutaneous methods, and also the Steindler operation of stripping of the os calcis. This latter method we believe to be far superior to any previous efforts to lengthen the plantar fascia. Forcible correction may be manual or accomplished by means of the Thomas wrench. There are forty patients in this series of cases. The average of years since operation is 7.7 years. The total number of operations performed is forty-three, and the average total success is 85.4 per cent. There were eleven lengthenings of the tendo Achillis alone, performed with the high percentage of 96.4 per cent. This exceedingly high average is due to the fact that the operation was performed for a very slight deformity, and that there was very little paralysis or weakness in the

extremity. There were sixteen forcible corrections performed, with a relatively low percentage (71.9 per cent.). Several of these were secondary operations following unsatisfactory previous procedures. The ultimate outcome, therefore, was not affected greatly by this operation. Tenotomy of the foot was performed but once, and the grade omitted on account of the small number. Plantar fasciotomy was performed alone twice. In each case the Steindler method was performed with brilliant results following as the percentage indicated (93.5 per cent.). There were combinations of these preceding operations performed in thirteen instances, and it is interesting to note that ten of these had plantar fasciotomies performed. Here again we have a relatively high average (89.5 per cent.).

In considering this group as a whole these operations were performed usually for minor disturbances and deformities, and not to be disdained as corrective measures for minor defects of the foot. In a later study of this group we hope to place astragaloscaphoid arthrodeses for the paralytic pronation deformity, of which we see a considerable number, but the operations are too recent to consider the results at this time.

SUMMARY CHART.

Minor Operations on the Foot.

Lengthening of Tendo Achillis, Forcible Correction, Plantar Fasciotomy.

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
No. of Patients in this series.....	40					
No. of Patients in this series who within the last ninety days have Replied to Inquiries.....						
Surgeons' Reports.....						
Are under observation.....	26					
No. of operations performed.....	43	21.3	20	22.4	22.3	85.4
Lengthening of Tendo Achillis...	11	22.4	24	24.6	25	96.4
Forcible Correction.....	16	20	15.9	18.9	17.1	71.9
Tenotomies of Foot.....	1					
Plantar Fasciotomy.....	2	21.5	23.5	23	25	93.5
Combination of the above operations performed on the same foot.....	13	20.7	20.1	23.7	25	89.5

Average No. of years since operation was performed 7.7

TENDON TRANSPLANTATIONS AND SILK LIGAMENTS.

Refer to Summary Chart.

There are twenty-nine patients in this series, and the average number of years since operation is 5.9 years. Thirty-four operations were performed in this series. Four of these were distinct successes, of which three were fixation of the tibialis anticus, and the other one a fixation of the tibialis anticus combined with tendon transplantations. The total average for this series is extremely low (66.6 per cent.). There were a few cases with extremely high grades (95 per cent.), bringing this average far above what it would have been, had we not had these few spectacular results.

Of the tendon transplantations there were fifteen with a total average of 63.4 per cent. There were ten tendon fixation operations with an average of 68.9 per cent. Three silk ligament operations were performed

SUMMARY CHART.

TENDON TRANSPLANTATIONS AND SILK LIGAMENTS ABOUT THE ANKLE.

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
No. of patients in this series.....	29					
No. of patients in this series who within the last ninety days have Replied to Inquiries..... Surgeons' Reports..... Are under observation.....	22					
No. of Tendon Transplantation alone.....	15	16.1	15.2	16.7	15.4	63.4
No. of Tendon Fixations alone...	10	16.2	13.6	20.2	18.8	68.9
No. of Silk Ligaments alone.....	3	15	10	10	10	45
No. of Tendon Transplantations and Tendon Fixations.....	1	25	20	25	25	95
No. of Silk Ligaments and Tendon Transplantation.....	5	15	16	15.2	11.7	57.7
No. of Silk Ligaments and Tendon Fixations.....						
No. of operations in this series...	34	18.1	14.9	17.8	16.2	66.6

Average No. of years since operation 5.9

with an average of 45 per cent. Five silk ligament and tendon transplantation operations gave an average of 57.7 per cent. We believe there are a few patients on whom tendon fixation is justifiable, particularly those having but slight disturbance of muscular balance. Further, that tendon transplantations even by one of the more advanced techniques advocated by Steindler, Biesalski and Mayer are rarely of value except when there is paralysis of but one muscle in a group of which there is a strong muscle available for transplant. Operations following the method of Gallie, Putti, and Peckham are perhaps commendable,—particularly when a tendon of the same functional group as the paralyzed tendon can be transferred with its sheath into a bony insertion. Silk ligaments have not been used in recent years in our clinic. On the whole, we are inclined to discourage this class of operations.

OPERATIONS ABOUT THE KNEE.

Refer to Summary Chart.

Under the special heading, operations about the knee, are considered transplantations of the hamstrings to quadriceps, lengthening of hamstrings, supracondylar osteotomy, and arthrodesis of the knee.

Transplantation of Hamstrings to Quadriceps.

The transplantation of the biceps or semi-membranosus into the quadriceps tendon and patella has brought very favorable results. There are eleven operations in this series. The average total number of years since the operations were performed is 5.2 years. With three of these cases, supracondylar osteotomy was performed, adding greatly to the function and stabilizing of the knee. The average grades for this series were, correction of deformity 21.4 per cent., improvement of function 20.7 per cent., additional comfort of patient 24.4 per cent., and lessening of apparatus 24.7 per cent., giving a total average of 91.7 per cent. There was one sartorial transplantation into the quadriceps which proved to be the only real failure from this type of operation. Our results for this series appear to be much more encouraging than those reported by many writers on this subject. The technique used is of the simplest nature, the biceps being more often the muscle transplanted, care being taken to fix this tendon firmly into the patellar substance, as well as into the quadriceps tendon. Of course the back knee deformity produced by osteotomy in combination with the hamstring transplantation is of tremendous aid in stabilizing the joint.

SUMMARY CHART.

Operations About the Knee.

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
Hamstrings to Quadriceps.						
No. of patients in this series	11					
No. of patients in this series who within the last ninety days have						
Replied to inquiries						
Surgeons' reports						
Are under observation	8					
No. of operations performed	11	21.4	20.7	24.4	24.7	91.7
Average No. of years since operation was performed—5.2						
Lengthening of Hamstrings.						
No. of patients in this series	8					
No. of patients in this series who within the last ninety days have						
Replied to inquiries						
Surgeons' Reports						
Are under observation	5					
No. of operations performed	10	23.4	16.6	20.6	22	82.6
Average No. of years since operation was performed 4.8						
Supracondylar Osteotomy.						
No. of patients in this series	5					
No. of patients in this series who within the last ninety days have						
Replied to inquiries						
Surgeons' Reports						
Are under observation	4					
No. of operations performed	5	21.8	21.0	23.8	25.0	90.6
Average No. of years since operation was performed 7						
Arthrodeses of Knee.						
No. of patients in this series	4					
No. of patients in this series who within the last ninety days have						
Replied to inquiries						
Surgeons' Reports						
Are under observation	3					
No. of operations performed	4	25.0	18.0	18.0	25.0	86.0

Average No. of years since operation was performed 3.6

Lengthening of Hamstrings.

The results obtained from lengthening of the hamstrings are far from being as satisfactory as the transplantation operation, as this procedure merely corrects deformity and adds nothing to the strength of the weakened quadriceps except as the muscle is relaxed by the new position and functions in a more normal manner. In this series there were eight patients on whom operations were performed. The average number of years since operation was 4.8 years, the grade for correction of deformity being 23.4 per cent., which is slightly above that of transplantations of the hamstrings, and the improvement of function is 16.6 per cent. which is considered below the hamstrings transplantation. The comfort of the patient (20.6 per cent.) is also lower than that of the previous operation, and the same fact is true of the grade for lessening of apparatus (22 per cent.), the total grade being 82.6 per cent. In reviewing the histories of these cases the paralysis is more extensive and severe than in the cases of the transplantation series, and the possibilities for improvement of function, increase in comfort, and lessening of braces are not so promising. The adequacy, however, of this operation as a corrective measure alone is conceded.

Supracondylar Osteotomy.

Supracondylar osteotomy has been found in our experience an operation of great aid in stabilizing not only the knee, but the entire lower extremity. Our series of patients is small, there being but five, yet seven years has been the average since these operations were performed. The percentage of success in these cases has been so uniformly high, that we feel justified in quoting the results. For correction of deformity, 21.8 per cent.; for improvement of function, 21 per cent.; for added comfort to the patient, 23.8 per cent.; and for less apparatus, 25 per cent.; giving a total of 90.6 per cent. Braces were ultimately not required by any of these patients having osteotomy of the femur. All of these patients had operations on the ankle and the highest grades accompanied those osteotomies performed with astragalectomies.

Arthrodeses of Knee.

There were four arthrodeses of the knee performed, with splendid results from the standpoint of correction of deformity (25 per cent.) and less braces (25 per cent.), but the improvement of function was only 18 per cent., and the general comfort of the patient was improved but

18 per cent., giving, however, a satisfactory total of 86 per cent. The average number of years since this operation was performed was 3.6 per cent. The function has been improved only so far as stability is concerned, likewise, the added comfort to the patient has been limited by the fact that the patient is not able to bend the knee, but the correction of deformity in every case was complete and braces were absolutely unnecessary. These two factors bring up the total grade and contribute greatly to the efficiency of the operation. Sir Robert Jones[27] in 1908 realized the efficiency of this procedure for patients in very moderate circumstances, who could not afford to buy expensive joint braces. On one of these patients arthrodesis of the ankle was combined with the knee arthrodesis; on another an astragalectomy with tendon fixation; these combined operations being uniformly satisfactory. This operation is advisable only when the extremity is extensively paralyzed. Of course if the gluteal group is inactive, the extremity is extremely difficult to completely stabilize with operative measures, without some mechanical appliances. To consider the operations about the knee as a whole, we feel justified from these results in encouraging particularly arthrodesis of the knee, supracondylar osteotomy, and transplantation of the hamstrings, preferably the biceps into the quadriceps tendon.

THIGH OPERATIONS.

Refer to Summary Chart.

Operations about the upper thigh in this series consist principally of those for correction of flexor, adduction, or abduction deformities. The Soutter method of separating the muscular attachments from the crest of the ilium has been used more extensively than any other procedure. In a few instances the Davis fascia lata operation has been performed, as also iliotibial band and fascial sectioning. The number of operations in this series is twenty-two, and the number of operations performed is twenty-eight. The average number of years since the operation is 4.03. The success so far as correction of deformity is concerned we consider very good (20.8 per cent.), but due to the severe paralysis existing in most of the patients requiring such operations, the function has been improved but 17.7 per cent. However, by this correction of deformity the comfort of the patient (20.8 per cent.) and the adaptabliity of the limb to braces (20.1 per cent.) has been sufficient to justify the procedure in this series, the total percentage being 80.4 per cent.

SUMMARY CHART.

Thigh Operations.

Souter, Davis Fascia Lata, Muscle and Fascia Sectioning.

		Cor. Def.	*Impr. Func.*	*Comf.*	*Less Braces*	*Total*
No. of patients in this series	22					
No. of patients in this series who within the last ninety days have						
Replied to Inquiries						
Surgeons' Reports						
Are under observation	15					
No. of these operations performed	28					
Average		20.8	17.7	20.8	20.1	80.4

Average number of years since operation was performed 4.03

SUMMARY

The purpose of an orthopaedic operation is: first, to correct deformity; second, to improve function; third, to give additional comfort to the patient; and fourth, to stabilize the foot sufficiently to make braces and splints unnecessary, or make it possible for the patient to wear apparatus previously unwearable on account of the deformity.

The average grades received by each operation performed in the treatment of infantile paralysis of the lower extremity in our series, and the extent to which each has fulfilled the above requirements, have been estimated, and from these grades the deductions made as follows—

1. Since most of these operations were performed before the war sufficient time has elapsed to estimate the ultimate result.

2. Operations of the paralytic lower extremity should return the part to at least within 20 per cent. of normal; that is, achieve a general average of 80 per cent.

20 per cent. Correction of deformity.
20 per cent. Improvement of function.
20 per cent. Additional comfort to the patient.
20 per cent. for apparatus lessened or made more wearable.

3. That arthrodesis of the ankle and astragalectomy uniformly meet the above requirements in every particular, and are by far the most stabilizing measures we have used for paralytic foot deformities.

4. Tendon transplantations, tendon fixations, and silk ligaments about the foot, as a class, do not meet the requirements outlined to a sufficient degree to warrant them as dependable operations. However, there were spectacular results in certain instances.

5. Lengthening of the tendo Achillis, plantar fasciotomy, and the various combinations of fasciotomies and tenotomies uniformly gave good results for the correction of minor paralytic deformities, although their success is largely dependable upon the long period of fixation and overcorrection. Forcible correction is usually inadequate, as many relapses occurred in this series.

6. Of the operations about the knee, transplantation of hamstrings to quadriceps and patella uniformly gave good results, and are therefore considered relatively dependable. Lengthening of the hamstrings mainly corrects deformity without increasing stability or function. Supracondylar osteotomy, by the production of a back knee, is a splendid stabilizing measure. Arthrodesis of the knee for stabilization of flail knee, if the patient has good gluteal muscles, is a splendid procedure, and should more often be considered in extensive paralytic involvement of the extremity, especially after the ankle has been stabilized.

7. Thigh operations such as fascia, muscular sectioning, and Soutter operations, for the correction of flexion deformities are of great help in making severely deformed individuals more comfortable, and in giving them an opportunity to wear practical braces.

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GENERAL CHART OF PATIENTS AND GRADES.

A Comparative Study of the Relative Value of Various Surgical Procedures in the Treatment of Infantile Paralysis of the Lower Extremity.

	Name	*Parts Affected*	*Date of Oper.*	*Operation*	*C-B*	*Re-ply*	*Time*		*Results in Percentage*
1.	Anderson	Equinus Deformity of foot	Dec. 5, 1919	Length. of Tendo Achillis	C	R	2		20 25 25 25 95
2.	Arlo, Howard	Equinus deformity	July 15, 1919	Length. of Tendo Achillis	C	S	3		25 15 25 25 90
3.	Arnold, Irma	Both	June 16, 1920	Astragalectomy					
				Length. of Tendo Achillis	C-B	S	2		20 20 20 25 85
4.	Baker, J. E.	Both	Oct. 4, 1921	R. Arthrodesis of Ankle	C	O	6	R.	20 18 20 15 75
			Aug. 26, 1921	L. Arthrodesis of Pan Astragaloid of ankle			mo.	L.	20 18 20 15 73
								Too short time—wears braces.	
5.	Barry	Complete paralysis of Both extremities	Mar. 30, 1920	Soutter	C-B	S		Ankle	20 20 22 25 87
			Apr. 16, 1920	Length. of Hamstrings			2	R.	25 20 25 25 95
			Jan. 25, 1921	Astragalectomy, Whitman			1	L.	20 20 25 25 90
								Legs straight. Feet stable	
			Mar. 15, 1921					Knee	20 20 25 15 80
6.	Belt	Both	Mar. 13, 1916	R. Forcible correction					25 25 25 25
			Dec. 4, 1916	Tendon Transplantation Sub. Periosteal Tib. Ant. Fixation	C	S	6	R.	25 25 25 25100
								L.	20 15 20 25 80
				L. Forcible correction Tendon transplantation					20 15 20 25
7.	Beins	Left Valgus	July 17, 1916	Astragalectomy, Whitman	C	R	7		20 23 25 23 91

	Name	Parts Affected	Date of Oper.	Operation	C-B	Re-ply	Time		Results in Percentage
8.	Beeler, Hallie	R. Equinus Valgus	Aug. 10, 1920	R. Arthrodesis of Ankle	C-B	R	2	R.	20 20 22 25 87
		L. Pronation	July 8, 1921	Arthrodesis of Astragalo Scaphoid		O S	1	L.	22 18 25 15 80
9.	Behmen	L. Talipes Valgus	Mar. 22, 1915	Peroneus Longus attached to Tib. Post. Extensor Communis Digitorum to Tib. Ant. Transfer Extensor Longus Hallucis		R S	7		15 10 15 0 40
				Tendon Transplantation	C-B				
10.	Bergan	R. Flail Foot	Sept. 12, 1919	R. Arthrodesis of Ankle					20 20 25 25 87
		L. Equinus deformity	Nov. 11, 1919	L. Loop Suspension		O	2		20 18 25 15 80
11.	Benson	Left Talipes Equino Varus	1910	Forcible Correction Length. Tendo Achillis	C-B	R	12		23 23 25 25 96
12.	Bolton	Equino Varus	July 15, 1911	Forcible Correction of				R.	20 22 25 25 90
		Flexion Contractures	June 2, 1913	Knees and Feet				L.	18 20 18 25 81
				Arthrodesis of both		S	12		
13.	Brewster	Equino Varus Flexion of Knees	Aug. 21, 1916	Peroneus Longus attached to Tib. Post.					
				Extensor Communis Digitorum to Tib. Ant.		S		Knee	20 20 20 25 85
								Foot	20 12 20 25 77
				Curved Supra Condylar Osteotomy Hamstrings to Quadriceps	C-B	S	6		
14.	Bryant	Left Talipes Equino Varus	June 29, 1916	Lengthening of Tendo Achillis	C	S	7		20 15 25 25 85
				Sub. Periosteal Tib. Ant. Fixation					

15.	Brown	Both Talipes Equino Varus	Nov.	16, 1914	Forcible Correction	C	S	8	R.		20	20	20	20	80
									L.		20	20	20	20	80
16.	Bragg	Lateral Curv. of Spine Thighs Flexed	May	10, 1921	Soutter	C	S	2	R.		15	10	10	10	45
									L.		15	10	10	10	45
17.	Brehm	Both Equino Varus	Nov.	8, 1915	Forcible Correction					L.	20	18	20	25	83
18.	Brezinski	Talipes Equino Varus	Feb.	15, 1915	R. Astragalectomy Whitman			7	Ankle	R.	18	20	25	25	88
		Knee Contractures	June	14, 1915	Forcible Correction				Ankle	L.	18	20	25	25	88
			July	19, 1915	Length. of Tendo Achillis										
			Oct.	2, 1915	Tendon Transplantation				Knee	L.	20	20	25	25	90
					L. Astragalectomy Whitman										
					Hamstrings to Quadriceps										
					Curved Supra Condylar Osteotomy										
19.	Brittin	Equino Varus and Cavus	June	8, 1919	Astragalectomy Whitman		R-2	12							
			Aug.	16, 1919	Peroneus Longus Tib. Post to Tendo Achillis			2			24	22	25	25	96
					Arthrodesis of Astraglo Scaphoid										
20.	Brooks	Talipes Equino Varus	July	18, 1919	Length. of Tendo Achillis		R	3			15	15	20	25	75
					Forcible Correction										
		Cavus deformity			Plantar Fasciotomy Steindler										
					Tenotomies of Foot Tendons										
21.	Burns	Right Foot	June	24, 1919	Tendon Transplantation	C	S	3			20	15	20	25	80
22.	Budler	Knee Contraction		1912	Soutter		R	10	Sout.		25	15	22	25	87
					Length. of Hamstrings				Knee		25	18	20	25	88
23.	Bufington	Flail Foot	May	4, 1920	Arthrodesis of Ankle	C	O	2			20	20	20	25	85
24.	Burlingham	Right Flail Foot	Oct.	11, 1921	Astragalectomy Whitman	C	O								
					Plantar Fasciotomy Steindler		5	6 mo.			20	10	20	10	60

	Name	*Parts Affected*	*Date of Oper.*	*Operation*	*C-B*	*Re-ply*	*Time*		*Results in Percentage*
25.	Casey H.	Both Varus	Sept. 23, 1919	Astragalectomy Whitman					
				Peroneus Longus Tib. Post to Tendo Achillis	C-B	S	3		23 22 25 25 95
26.	Casey A.		Nov. 2, 1914	Fascia Lata Division		S	7		20 22 25 25 92
27.	Chapman		Apr. 4, 1915	Forcible Correction			7		
28.	Champan, A.G.	Equino Varus both	July 21, 1913	Length. of Tendo Achillis					
				Plantar Fasciotomy		S	8		24 25 25 25 99
29.	Clausen	Both	June 10, 1915	Forcible Correction			8		
30.	Cole E.	Flail Ankle	Since 1919	Arthrodesis of Ankle	C-B	S	3		21 18 20 25 84
		Talipes Equinus and Cavus		Plantar Fasciotomy Nail					
31.	Cole E.	Flail Ankle	R.	R. Astragalectomy Whit.		R	8	R.	20 20 20 26 86
				L. Forcible Correction				L.	20 20 20 25 85
32.	Connely	Equinus		Forcible Correction			7		20 15 20 25 80
				Sub Periosteal Tib. Art. Fixation		S			
33.	Cohee	Both lower extremities contracted	June 26, 1914	R. Soutter					
			Mar. 20, 1916	Hamstrings to Quadriceps					
				L. Arthrodesis of Ankle					
				Length. of Tendo Achillus					
				Transfer Extensor Longus Hallucis					
				Forcible Correction	C-B		8		
34.	Coop	Valgus Deformity Rt. and Left	1908	R. Tenotomy and Length. of Peronei					
			1913	Tendon Transplantation		S	12-8	R.	15 15 15 10 55
				Silk Ligaments Achillis				L.	15 18 15 15 63
				Tenotomies of Foot Tendons					
				L. Same					

35.	Coleman W.	Both	1917	R. Astragalectomy Whitman	C	R	5	Ankle	R	23	23	23	25	94
			1921	Lengthening of Hamstrings		O	L	Knee		25	20	25	25	95
				Tendon Transplantation										
				L. Astragalectomy Whitman				Ankle	L.	25	18	18	15	76
				Lengthening of Hamstrings				Knee		25	10	18	15	68
36.	Clark	Complete Paralysis	Dec. 29, 1913	R. Silk Ligaments					R.	15	10	10	10	45
			Mar. 2, 1914	L. Astragalectomy Whitman	C		11		L.	22	20	25	25	92
37.	Crawford	Talipes Equino Varus Right		Length. Tendo Achillis										
				Forcible Correction										
				Astragalectomy Whitman		S	8			20	18	25	25	88
				Loop Suspension Jones										
38.	Davis	Flail Ankle Left	Apr. 12, 1921	R. Peronei Longus										
				L. into Astragalus	C	S	1			20	18	25	25	88
39.	Dennis	Flexion Thigh Left	Sept. 11, 1916	Soutter		S	6			25	20	25	25	95
40.	Depeu	Equinus Rt. Foot	Nov. 7, 1916	Length. of Tendo Achillis Soutter			6							
41.	Diller	Flail Foot Left	July 21, 1920	Astragalectomy Whitman		R	2			20	22	25	25	92
42.	Dizney	Flexion of Knees Equinus	Feb. 22, 1915	Plantar Fasciotomy										
				Forcible Correction										
				Length. Tendo Achillis					R.					
				Length. of Hamstrings Soutter					L.					
				Fascia Lata Division		R								Died
43.	Dolman	Both	Jan. 22, 1917	Soutter										
			Feb. 19, 1917	Curved Supra Condylar										
			Dec. 6, 1917	Osteotomy										
			Nov. 5 and 6, 1917	Length. of Tendo Achillis	C-B									Died

	Name	Parts Affected	Date of Oper.	Operation	C-B	Re-ply	Time		Results in Percentage				
44.	Dunn	Equinus Valgus Flail Both	July 9, 1921	Arthrodesis of Ankle	C	R	6 mo.		22	20	23	25	90
45.	Edwards	Both		Forcible Correction	C-B								
46.	Edwards	Flail Left Foot	July 29, 1912 Apr. 21, 1913	Astragalectomy Whitman	C-B		10						
47.	Elliot	Complete Paralysis Both	Oct. 10, 1914	Arthrodesis Davis	C	O		R.	20	20	20	25	85
				Arthrodesis of Astraglo Scaphoid		S	8	L.	20	20	13	18	73
48.	Elliot	Both Lower extremities	1913	Tendon Transplanation	C-B	R	9	R.	10	10	5	0	25
								L.	10	10	10	0	30
								Oper.	fail.		Arth.		Later
49.	Feather	Talipes Equino Varus	Feb. 11, 1918 Jan. 20, 1918	Forcible Correction Length. Tendo Achillis Soutter	C-B		4		25	25	25	25	100
50.	Fox	Equino Varus Right	Sept. 28, 1920	Astragalectomy Whitman Tenotomies of Foot Tendons	C		2		18	20	22	25	85
51.	Fish, E.	Both	Aug. 8, 1920	Length. Tendo Achillis	C-B	O	2	Thigh	20	18	25	16	79
				Astragalectomy Whitman Soutter		R		Whit.	20	10	15	10	55
								Sout.	20	15	25	16	76
								Whit.	20	18	25	16	79
52.	Geyman, M.	Contractures Both	Nov. 15, 1919	Soutter	C-B	R	2	Thigh	22	20	20	20	82
				Arthrodesis of Ankle		S		Foot	20	22	23	25	90
				Length. Hamstrings		O		Knee	20	20	20	20	80
53.	Gelhart	Equinus and Contractures	Dec. 22, 1911	Forcible Correction	C		11						
			Jan. 13, 1913	Length. Tendo Achillis			9						
				Length. Hamstrings Soutter			3						

54.	Gooshey	Both	Apr. 7, 1911	Davis Arthrodesis Rt. and L.											
			Oct. 10, 1914	Arthrodesis of Astragalo											
			Mar. 22, 1915	Scaphoid			3								
			Nov. 11, 1919	Arthrodesis of Knee Rt.			2								
			Jan. 2, 1920	Lengthening of Hamstrings											
			Dec. 14, 1920	Astragalectomy Whitman											
				Sub. Periosteal Tib. Ant. Fixation											
				Peroneus Longus Tib. Post to Tendo Achillis											
55.	Goff	Right	Sept. 30,1919	Arthrodesis of Ankle											
				Sub. Periosteal Tib.				Knee	25	18	18	25	86		
				Ant. Fixation	C	S	2	Ankle	21	18	25	25	89		
				Arthrodesis of Knee											
56.	Gordon, G. B.	Contracture Rt. Leg	Apr. 9, 1921	Soutter		S		Thigh	20	18	23	24	85		
				Hamstrings to Quadiceps		R		Knee	20	22	23	22	87		
				Tibialis Post to Ant.	C-B	O	1	Ankle	16	20	23	15	74		
57.	Griffin	Flail Equino Varus	July 25, 1919	Astragalectomy Whitman		R	4		22	20	22	25	89		
		Rt. Leg		Peroneus Longus Tib. Post to Tendo Achillis		R									
58.	Grinstead	Both		Arthrodesis of Knee											
59.	Hayward	Both	May 11, 1920	Length. of Tendo Achillis											
				Tendon Transplantation		S	2		15	15	15	25	70		
				Not Recorded	C										
60.	Hardesty	Equinus	Nov. 6, 1916	Astragalectomy Whitman											
			Apr. 9, 1917	Plantar Fasciotomy											
			June 18, 1917	Forcible Correction	C	S	5		20	20	20	20	80		
				Tendon Transplantation											

	Name	Parts Affected	Date of Oper.	Operation	C-B	Reply	Time		Results in Percentage
61.	Henderson	Back Knee Left Leg	May 28, 1919	Shortening of Biceps		R	3		24 24 25 25 98
62.	Hubert	Equinus Varus and Cavus	July 8, 1919 Sept. 9, 1919	Plantar Fasciotomy Length. of Tendo Achillis		R	3		24 24 25 25 98
63.	Hudson	Equinus Deformity	July 1, 1916	Tenotomy of Tendo Achillis			6	R. L.	25 25 25 25 100 25 25 25 25 100
64.	Jackson	Both	Dec. 7, 1914	Arthrodesis of Ankle		R	9		
65.	Johnson, C.	Flail Foot Left Leg	Sept. 23, 1919	Arthrodesis of Ankle	C-B	R R	3		23 20 20 25 88
66.	Johnson, F.	Both	Feb. 15, 1909 June 4, 1909 June 30, 1913 Nov. 16, 1914 June 21, 1915	Tendon Transplantation Failure Astragalectomy Whitman Curved Supra Condylar Osteotomy				Knee	25 22 25 25 97
				Arthrodesis Davis Operated twice 1 Yr. Apart	C-B S	O	1	Ankle	20 20 20 25 85
67.	Joy	Both Equinus	Apr. 17, 1911 Nov. 24, 1913 Mar. 22, 1915	Forcible Correction Performed 3 times 2 years apart	C	R	11 9 8	R. L.	20 10 15 10 55 20 15 20 25 80
68.	Klossner	Claw Foot Left Leg	June 21, 1921	Arthrodesis of Ankle	C-B	O S	1		20 20 20 18 78
69.	Koper	Equinus Left Foot	June 28, 1916	Length. Tendo Achillis	C-B	O	6		25 22 25 25 97
70.	Kedl	Equino Varus Rt. Foot	May 26, 1916	Length. Tendo Achillis Tendon Transplantation Tib. Post. Sub. Periosteal Tib. Ant. Fixation		S	6		10 10 15 25 60
71.	Knight	Both	Sept. 21, 1920 June 21, 1921	Arthrodesis of Ankle Soutter	C	S	2	Ankle Leg	20 20 22 25 87 22 21 24 25 92

72.	Kollmorgan	Flail Foot	May	28,1915	Forcible Correction		R	7		20	20	25	25	90
			June	19, 1915	Peroneus Longus Tib. Post. to Tendo Achillis		R							
					Tendon Transplantation									
					Arthrodesis Davis									
73.	Krupa	Flail Foot	Feb.	17, 1913	Forcible Correction	C	S	8		15	15	15	10	55
		Left Leg	Jan.	19, 1914	Part of Tendo Achillis									
			July	1, 1914	into Tib. Post									
					Silk Ligaments									
					Fascia Lata Division Davis									
74.	Lipe	Flail Foot	July	5, 1921	Astragalectomy Whitman Nail	C-B	R	1		20	15	20	18	73
		Both					O							
					Plantar Fasciotomy									
75.	Ludwickson	Both	Sept.	11, 1915	R. Sub. Periostel Tib. Ant. Fixation					20	18	25	25	88
					L. Length. Tendo Achillis	B	S	7	L.	25	25	25	25	100
76.	Mahoney	Both	July	14, 1921	Astragalectomy Whitman Nail	C-B	R	1		23	18	20	18	79
							O							
77.	Mangold	Both	July	15, 1920	Soutter		R		L.	20	18	20	22	80
		Very bad deformity			Astragalectomy Whitman	C-B	O	2	R.	18	15	18	23	74
										20	18	20	22	80
78.	Martin	Equino Varus	Feb.	19, 1917	Arthrodesis of Ankle			5						
			Mar.,	1919	Peroneus Longus into									
			Sept.	7, 1914	Astragalus—Nail									
79.	Martin, M. E.	Flail Foot	Feb.	24, 1920	Astragalectomy Whitman		R	2		22	25	25	25	97
							O							
80.	Maxwell	Equino Varus	July	15, 1912	Silk Ligaments			8						
			July	1, 1914	Fascia Lata Division Davis									
			Jan.	25, 1915	Arthrodesis of Astraglo Scaphoid									
					Forcible Correction									

	Name	Parts Affected	Date of Oper.	Operation	C-B	Re-ply	Time		Results in Percentage				
81.	Mason	Thigh Flexion	Nov. 22, 1917	Soutter			5						
82.	Mary Bessie	Equino Varus	Aug. 7, 1915	Length. of Tendo Achillis									
			Sept. 29, 1915	Plantar Fasciotomy									
			Nov. 19, 1915	Forcible Correction									
			July 20, 1916	Arthrodesis of Ankle Sub. Periosteal Tib. Ant. Fixation			7						
83.	Melikoff	Equino Valgus	June 23, 1912	Silk Ligaments			10						
84.	Meyers	Both	Apr. 17, 1911	Forcible Correction									
85.	Miller	Both	Oct. 4, 1921	Soutter		R	1	Thigh	23	20	25	25	93
				Length. of Tendo Achillis	C	O		Foot R.	25	20	25	25	95
								Foot L.	22	25	25	25	97
86.	Mott	Both	Aug. 29, 1919	R. Tib. Post. Sub Periosteal									
			Oct. 21, 1919	Tib. Ant. Fixation Failure		R	3		20	21	24	18	83
			Jan. 13, 1920	R. Astragalectomy Whitman		O			19	20	24	18	81
				L. Arthrodesis of Ankle		C							
87.	McGovern	Equinus and Cavus	June 23, 1916	Length. Tendo Achillis Arthrodesis of Astragalo Scaphoid Plantar Fasciotomy Fascia Lata Division Davis Tenotomies of Foot Tendons Tendon Transplantation			7						

88.	McFarland	Equinus Left Leg	Sept.	6, 1920	Transfer Extensor Longus Hallucis Length. Tendo Achillis Tib. Post. Sub. Periosteal Tib. Ant. Fixation	C-B	O R	1	22 22 23 25 92	
89.	McKay	Talipes Equino Valgus and Varus			Astragalectomy Whitman		O	1	20 18 18 15 73	
90.	McDermed		May	1, 1916	Arthrodesis of Ankle—Nail					
			Oct.	24, 1916	Arthrodesis of Astragalo Scaphoid Peronei Longus into Astragalus			6		
91.	McFarlane		Aug.	8, 1920	Length. of Tendo Achillis Transfer Extensor Longus Hallucis					
92.	Newell	Equino Valgus	Mar.	6, 1910	Tenotomies of Foot Tendons			12		
93.	Norall	Equinus Def.	May	17, 1915	Length. Tendo Achillis Arthrodesis Davis Arthrodesis of Astragalo Scaphoid		R	8	15 15 25 25 80	
94.	Odell	Left Foot	Dec.	6, 1915	Arthrodesis Davis			7	22 20 25 25 92	
95.	Olsen	Right Leg	July	30, 1917	Plantar Fasciotomy Length. Tendo Achillis Peroneus Longus into Astragalus Tendon Transplantation Forcible Correction Astragalectomy Whitman			5		
96.	Owen	Both	Aug.	17, 1920	Plantar Fasciotomy	C-B	O	2	18 22 23 25 88	

	Name	Parts Affected	Date of Oper.	Operation	C-B	Reply	Time		Results in Percentage
97.	Parks	Equinus Quadriceps Weakness	May 1906	R. Plantar Fasciotomy Length. Tendo Achillis Sartorius Transplantation L. Length. of Tendo Achillis		R 18 O	Foot R.		20 18 20 25 85
							Knee R.		22 20 22 25 89
							Foot L.		22 22 23 25 83
98	Palmer	Equinus Varus Flail Rt. Foot	1914	Astragalectomy Whitman		R 8 R R R			20 22 25 25 92
99.	Pearl	Left Foct Varus	Sept. 18, 1916	Astragalectomy Whitman	C-B	R 6			22 22 23 25 92
100.	Peck		Sept. 6, 1909	Lengthening of Tendo Achillis	C	R 4			23 23 25 25 96
101.	Peterson	Varus Quadriceps Weakness	June 26, 1917	Hamstrings to Quadriceps Astragalectomy Whitman	C	5			
102.	Plessinger	Varus Quad. Weak	Oct. 16, 1916	Arthrodesis of Ankle Sub. Periosteal Tib. Ant. Fixation			Ankle		23 23 24 25 95
				Hamstrings to Quadriceps	C-B	R 6	Knee		22 23 24 25 94
103.	Ponton	Equino Varus	June 29, 1916	Astragalectomy Whitman	C-B	6			20 22 23 25 90
104.	Pollock	Rt. Leg	Sept. 23, 1921	Tib. Post Sub. Periosteal Tib. Ant. Fixation		O			
				Arthrodesis of Ankle	C-B	S 1			22 20 24 15 81

105.	Porter	Both	Sept.	12, 1910	Arthrodesis of both Shoulders											
			Oct.	24, 1910	Ligament shortening											
			Dec.	12, 1910	Arthrodesis of Astraglo Scaphoid											
			July	26, 1912	Plantar Fasciotomy											
			Oct.	7, 1912	Tenotomies of Foot Tendons											
			Apr.	17, 1911	Silk Tendons into Elbow											
			May	22, 1911	Loop Suspension Jones											
			June	8, 1911	Cuneiform Osteotomy of Tarsus											
			June	23, 1912												
			May	26, 1913												
			Oct.	10, 1913												
			Nov.	17, 1913												
			Jan.	5, 1914												
106.	Puckett	Marked Equino Varus	June	29, 1916	Whitman Astragalectomy Sub. Periosteal Tib. Ant. Fixation											
					Length. of Tendo Achillis			7								
107.	Reed	Calcaneo Cavus	Mar.	22, 1921	Plantar Fasciotomy Peroneus Longus. Tib. Post. to Tendo Achillis		S		Sout	22	20	24	25	91		
					Arthrodesis of Ankle Soutter	C-B	O	1	Arth	18	23	23	25	88		
108.	Rhodey	Equinus Valgus Left Leg	Jan.	6, 1919	Sub. Periosteal Tib. Ant. Fixation			2								
109.	Richards	Right			Length. Tendo Achillis Forcible Correction	C	R	13		25	20	25	25	95		

	Name	*Parts Affected*	*Date of Oper.*	*Operation*	*C-B*	*Re-ply*	*Time*		*Results in Percentage*
110.	Riggins	Both	July 7, 1913	L. Hamstrings to Quadriceps			9		
			Feb. 16, 1914	Transfer Extensor Longus			8		
			June 14, 1915	Hallucis			7		
				Silk Ligaments					
				R. Astragalectomy Whitman					
111.	Rodenbaugh	R. Equino Varus	Mar. 15, 1915	R. Astragalectomy Whitman later					
		L. Valgus	July 13, 1914	Forcible Correction					
				Silk Ligaments					
				R. Peroneus Longus. Post to Tendo Achillis				R.	20 20 25 25 90
				Failure					
				R. Tendon Transplantation			7		
				Supra Condylar Osteotomy					
112.	Schoonover	Equino Varus	Nov. 8, 1915	Length. of Tendo Achillis					
				Forcible Correction					
				Tendon Transplantation	C-B		7		
113.	Schlaik	Flail Foot	June 28, 1921	Astragalectomy Whitman	C-B	O R	1		20 20 18 10 68
114.	Schmitz	Both	Sept. 14, 1914	Forcible Correction	C	S	8	R.	20 10 15 10 55
								L.	20 10 15 10 55
115.	Schmitz, W.		1919	Soutter					
116.	Schmitz, Mary	Equino Varus	Apr. 19, 1916	R. Arthrodesis of Ankle—nail			6	R.	18 15 15 10 58
		Contracture of Knees	June 25, 1917	Curved Supra Condylar Osteotomy				L.	20 15 20 20 75
				Arthrodesis of Ankle				Knee	15 15 10 10 50

117.	Schukar	Rt. Leg	Jan.	5, 1914	Nail Fixation		R	8		15	18	18	25	76
118.	Sexton	Rt. Foot Valgus	Sept.	20, 1915	Forcible Correction	C-B	R	7						
119.	Shea	Rt. Foot Varus	Feb.	1921	Arthrodesis of Ankle	C	S O	1		22	18	10	18	78
120.	Sickert	Equino Varus Rt. Foot	June	24, 1915	Astragalectomy Whitman		R S O	7		20	20	20	25	85
121.	Smith, D.	Calcaneo Cavus both	Apr. Aug.	19, 1915 9, 1915	R. Excision of Head of Astragalus Arthrodesis of Ankle Tib. Anticus to Cuboid Transfer Extensor Longus Hallucis L. Excision of head of Astragalus Arthrodesis of Ankle Tib. Ant. to Cuboid Tendon Transplantation	C		7						
122.	Smith	Contractures of Toe Pronation both Feet	Jan. Mar.	16, 1920 19, 1921	Transfer Extensor Longus Hallucis Tendon Transplantation	C-B	O R	2	R. L.	20 20	22 18	22 22	25 25	89 85
123.	Smith, M. O.	Varus Left Leg	July	13, 1920	Arthrodesis of Ankle	C-B	S O	2		10	15	18	25	68
124.	Stewart	Varus and Cavus both feet	Nov.	2, 1920	R. Length. Tendo Achillis Astragalectomy Whitman L. Plantar Fasciotomy	C-B	O R	2	R. L.	22 25	20 25	23 23	25 25	90 98
125.	Stauffer	Severe Contractures Complete Paralysis			Arthrodesis of Ankle Soutter		R O	2	Leg Ankle	20 21	20 15	20 10	10 20	70 66

	Name	Parts Affected	Date of Oper.	Operation	C-B	Reply	Time	Results in Percentage					
126.	Strickler	Equino Varus Quadriceps Weak	1916	Astragalectomy Whitman		R	6	Ankle	25	22	25	25	97
				Hamstrings to Quadriceps				Knee	24	24	25	25	98
				Arthrodesis of Wrist	C-B								
127.	Sturms	Lateral Unstability	Mar. 30, 1920	Tendon Transplantation									
				Extensor Hallucis to Tib. Post.	C-B	R	3		15	15	15	10	55
128.	Spritzel	Talipes Valgus Quad. Weak Flail	June 17, 1917	Hamstrings to Quadriceps									
				Tib. Post. Sub. Periosteal									
				Tib. Ant. Fixation	C	R	5	Knee	24	22	25	25	96
								Ankle	15	18	20	10	63
129.	Suard, B.	Both feet	June 21, 1921	R. Arthrodesis of Foot		O	6 mo.	R.	20	25	25	15	85
				L. Forcible Correction	C-B	R		L.	20	25	25	25	95
						R							
130.	Suit	Both	Mar. 22, 1915	Forcible Correction	C-B		6						
131.	Sundstrom	Flail Foot	July 3, 1916	Tib. Post. Sub. Periosteal									
			July 24, 1916	Tib. Ant. Fixation									
				Tendon Transplantation	C-B	R	6						
				Davis Modified									
132.	Taylor	Both	1909	Soutter			13						
133.	Thompson, D.	Both	July 24, 1916	Forcible Correction		R	6	R.	18	18	25	25	86
				Plantar Fasciotomy				L.	18	18	25	25	86
134.	Thompson, Fern	Equino Varus both	Sept 27, 1915	Tenotomies of Foot Tendons	C-B		7						
				Plantar Fasciotomy									
				Forcible Correction									
135.	Theobald	Flail Both	June 1, 1920	Arthrodesis of Ankle				Knee	22	15	20	25	82
				Length. of Hamstrings	C-B	O	2	Ankle	22	20	23	25	90

136.	Vandermuelen	Valgus Right	July	3, 1916	Tendon Transplantation												
			Oct.	2, 1916	Forcible Correction		R	6			10	10	10	10	40
137.	Wallen	Both	Dec.	1919	L. Astragalectomy Whitman				L.		18	20	20	25	83
										Whit. performed by Dr. Stern.						
					R. Peronei Longus into Astragalus				R.		20	20	22	25	87
138.	Walgren	Equinus	July	7, 1921	Forcible Correction	B	O R	1			20	20	20	10	70
139.	White	Complete Paralysis	Feb.	28, 1916	Forcible Correction	C-B		6							
140.	Whissenand	Flail Rt. Foot	Sept.	13, 1921	Astragalectomy Whitman Nail	C-B	O	1			22	18	23	15	78
141.	Wilson	Left Flail Ankle	July	5, 1921	Arthrodesis of Ankle	C-B	O	1			20	10	20	15	65
142.	Worth	Equino Valgus Left	Oct.	12, 1920	Astragalectomy Whitman		R	2			20	20	20	25	85
					Tenotomies of Foot Tendons		S								
143.	Woods	Both	Dec.	4, 1916	Length. Tendo Achillis										
			Jan.	14, 1917	Plantar Fasciotomy										
					Forcible Correction	C-B		6			23	22	25	25	95
144.	Zotsman	Both	Dec.	9, 1919	Soutter										
			Feb.	3, 1920	Sub. Periosteal Tib.										
			Dec.	7, 1920	Ant. Fixation, Failure Whit. later			5	Sout.		25	22	20	25	92
					Hamstrings to Quadriceps		R	2	Knee		25	18	20	25	88
					Astragalectomy Whitman	C			Whit.		20	22	25	25	92

AN OPERATION FOR THE CORRECTION OF PLANTAR AND ADDUCTION CONTRACTION OF THE FOOT ARCH.*

BY J. T. RUGH, M.D., PHILADELPHIA, PA.

Accuracy of observation as well as of description is one of the most desirable qualities in the record of a disease or a deformity, but unfortunately it is too often lacking in writers. A search and study of the literature of any given condition will show the truth of this statement and in no one more than the so-called cavus or hollow foot deformity. So many factors surround its occurrence and exert such a profound influence upon its integral anatomy and pathology that without their detailed and careful consideration, the case report and operative description become valueless. In the first place, the etiology of the condition is extremely varied. There is the congenital form, which is most commonly associated with the varus of club-foot. In this, the varying degrees of the deformity play a most important part in that they indicate fairly accurately the structures chiefly involved in the condition. They also determine the method of treatment to be employed—that is, whether the soft or the bony tissues shall receive the chief consideration.

Spina bifida has been proven a factor in the causation either by trophic interference, by muscle changes or by trophic influences direct, and the occult form has been suspected to be the cause in certain cases. Certain degenerative lesions of the spinal cord or of the nerve trunks have also been accompanied by these contractures. Infantile paralysis is probably the most frequent cause of the acquired cases coming under the care of the orthopaedic surgeon and produces the most difficult class to treat by reason of the great muscle imbalance in addition to the faulty postures and great joint relaxations. Faulty shoes, arthritis (traumatic or toxic), scars following operations or injuries, fibrositis, myositis, and trophic lesions of any type are among the many conditions which may underlie this deformity. The cause should always be determined, if possible, as it may influence most profoundly the prognosis of the case. The age of the patient is also of great importance, by reason of the greater elasticity of the tissues in early life and hence the greater possibility of

*Read at the Annual Meeting of the American Orthopedic Association, June, 1923.

change from treatment. The length of time the conditions have existed is likewise an important factor on account of the progressive nature of the deformity and the increasing permanency of the tissue changes.

The pathology of the condition is primarily that of the cause and secondarily that of the local changes in the tissues. The soft parts practically all present fibrous changes with thickening and subsequent lessening of the vascularity of the tissues. With the cell proliferation, there is formation of scar tissue and a tendency to contract, and any injury added to this by operative measures only increases this tendency.

FIG. 1

There has been a great variation of opinion as to the structures involved in these cases, some claiming the chief offender to be in the soft parts, while others consider it in the bony parts. There may be several. The skin shortens secondarily to the underlying structures unless there is a scar, as from an old Phelps operation for club-foot or from a burn or trauma. The plantar fascia is also shortened either primarily or secondarily. The flexor brevis and accessory muscles of the sole of the foot and the long flexors of the toes are at times most important in preventing the correction after other soft parts have been divided. The calcaneo-scaphoid, calcaneo-cuboid and astragalo-scaphoid ligaments have been

cited as the chief factors in the deformity and doubtless are in certain cases. Change in the bony form and structure may also be primary or secondary and prove the greatest obstacle in the correction and cure of the condition. Thus it will be seen that all of the component parts in the sole and bony framework of the foot must be considered in the study of the deformity and this fact demonstrates the impossibility of curing all cases by one method of treatment. The underlying cause, the length of time it has existed, the parts involved and the age of the patient are the most important factors in determining the prognosis and treatment. In the true claw-foot, there are always profound trophic changes which require special methods of treatment, and it is not the writer's intention to consider this in any detail. Many different types of operation have been proposed for the relief of the milder forms of contraction. The simplest operation is subcutaneous section of the contracted soft parts, and if the muscle balance is not too greatly disturbed, this may suffice to relieve. Very careful, thorough, and persistent after-treatment is essential to the maintenance of correction, as the tendency to relapse is very great. Properly fitted shoes, especially as regards the length, are essential, and a metatarsal pad placed behind the heads of these bones will aid in maintaining stretching of the severed structures.

Many English operators dissected out the plantar fascia and endeavored to hold the foot extended, but contraction of the scar was very common and the resultant condition was worse than the original. Phelps' operation permitted easy correction in most cases, where only the soft parts were involved. In his hands, the results were good by reason of his thorough after-treatment, but many other operators met defeat through subsequent contraction of the scar following the deep incision across the foot sole. Phelps did not hesitate to combine osteotomy to improve the effects of his skin and fascial section, as he realized fully that the deformity was of such complex character in many cases that bone section was necessary for correction. Transplantation of the active dorsal flexor muscles, especially the extensor longus hallucis into the midtarsal or metatarsal area in paralytic cases, helps if the changes in the arc of the arch are not too great and the transplanted muscles are strong. In the presence of bony changes and added deformities, failure is common. Stripping of the under surface of the arch (Steindler) succeeds in those cases in which the ligaments are the chief factors, but relapse occurs in some cases from contraction of the scar as in other operations on these parts. Ankylosing operations on the bony parts are fairly successful in later childhood and adult life, but are chiefly indicated in the paralytic

cases and where there are fairly marked changes in the shape and articulations of the bones. Extensive remodeling as described by various operators is sometimes necessary.

In 1889, Keetley described a plastic operation for the filling in of the gap in the incision of the skin, similar to that of Phelps. He cut a flap

FIG. 2

from the redundant skin on the outer and dorsal side of the foot and turned this over to cover the raw surface on the inner and under surface of the foot. A similar procedure was later advocated by Kellock and Muirhead Little. A longitudinal incision cutting the skin and fascia has also been employed with varying success. The multiplicity of pro-

cedures reported in literature demonstrates clearly the search for some plan which will eliminate subsequent contractures. There are but three methods which meet this requirement. The first is only partially successful, because of the time and patience required for its accomplishment. It consists in the careful and complete section of all contracted soft structures, thorough correction of the deformity and then maintenance of the correction by persistent and long continued manipulations and suitable braces, until sufficient power is developed in the dorsal flexors to resist efforts at contraction.

The second is the interposition of a fascial transplant (free or pedicled) to interrupt the scar continuity and prevent contraction. This may be accomplished in several different ways which will be considered shortly.

The third is the careful and thorough bone operations on those cases in which there are structural bony changes, and which have been described in detail by various operators and authors.

The writer's attention was first called to the plastic procedure (second plan) in the attempt to correct the cavus and slight varus following a Phelps operation done by a well-known and efficient orthopaedic surgeon fifteen years previously. Several operations had been done to relieve the deformity but relapse followed each effort. In February, 1920, the old scar was dissected out, the foot easily overcorrected, and a pedicled flap of skin, fat, and fascia transplanted from the calf of the opposite leg. This solved the problem and effected a cure. The thought then offered itself why not in other cases do a Phelps incision and follow the straightening with a transplant from the opposite leg, and this was tried with complete success. The second case was one of a fairly pronounced cavus with a scar of the plantar surface, the result of an operation for the correction of the original clawing deformity in a girl fourteen years of age. Here, too, the scar was dissected out, together with part of the plantar fascia in its entire width, and a pedicled flap was grafted from the opposite leg. This recovered and three years after showed no evidence of recurrence. The technique is as follows: Beginning in front of the internal malleolus, a little higher or lower than the tibialis-posticus tendon, (according to the height of the skin contraction), an incision is made transversely across the sole as far as necessary to free the skin shortening. The fascia is then cut and the flexor brevis and adductor hallucis are either over-stretched or cut. If correction is not yet complete, the tibialis posticus and the flexor longus tendons are severed; the accessorius usually gives no trouble. If there still is resistance, a narrow

bladed knife is slipped close under the astragalus, and the astragalo-scaphoid ligament or any other underneath the foot arch is divided, and over-correction is easily accomplished. Any bony deformity can also be dealt with after this time if it be found needful. The wound is packed

FIG 3.

firmly with gauze to check all bleeding and a plaster cast is applied to the foot to maintain it in over-correction.

An opening is next cut in the inner and under side of the cast, of sufficient size to allow sewing of a graft in place. At a suitable height on the inner side of the calf of the opposite leg, an elongated flap of skin,

fat, and fascia is lifted, of sufficient width and length to easily cover the incision in the sole of the foot. The edges of the wound under the flap are drawn together by silkworm gut sutures and a pad of gauze is laid over the sutured incision. The sole of the involved foot is then approxi-

FIG. 4

mated to the flap, the gauze packing is removed and the flap is sewn in place with silkworm gut, care being taken to secure accurate coaptation of skin edges. Copious dressings are applied all about the area and between the plaster cast and the calf of the leg, and an investing cast

FIG. 5

is applied to hold the two parts in firm position until union obtains. It is well to flex the knee of the host leg about 20° and hold it so in plaster, as this position is more comfortable for the patient. After eighteen to twenty-one days, the cast is cut and the base of the flap separated from the leg and carefully folded into the outer end of the incision in the foot sole, which will have to be opened a little to receive it. This heals in a week, the cast being worn on the foot all the time, and the patient is then encouraged to begin walking. After another week, the cast can be removed and a proper shoe with a firm shank is fitted. The operation is simple and easy of performance and the results are good, if care is taken to entirely release the contracted soft parts and secure sufficient length and breadth of flap.

If the skin is not much shortened and the fascia and tendons are the main offenders, it is not necessary to transplant the skin flap, though the same principle of interposition of fat and fascia to interrupt the line of contraction is indicated and is accomplished as follows: A longitudinal incision is made in the sole of the foot, and the plantar fascia dissected out entirely, or in part, the tendons cut and thorough stretching done, and then a free fascial flap taken from the side of the thigh is transplanted into the sole of the foot in the place of the removed plantar fascia, and the incision closed. Plaster is then applied with as full correction as possible for a period of three to four weeks. Walking is begun in ten days or two weeks. This is followed up by massage and stretching for some time to insure thorough restoration of function in the sole of the foot, and a flat-soled shoe with firm shank will enable the foot to stretch from weight-bearing and prevent buckling of the shoe from too great a muscle pull.

There is also no reason why tendon transplantation should not be done on the dorsum of the foot in addition to the flap transplantation to secure an extra force toward maintaining correction, and in certain of the paralytic cases it would be eminently indicated. Arthrodesis of the midtarsal joints may also be done and in paralytic cases is especially indicated.

The whole purpose of the transplant is the interruption of the continuity of tissues which are pathologic and which constantly tend to shorten as a result of the inherent changes arising from the underlying causative factors.

DISCUSSION ON PAPER OF DR. RUGH.

Dr. Compton Riely, Baltimore, Maryland: I have never performed the Phelps operation or modifications of it. We see bad results from these operations at times where the patients are compelled to walk on crutches. In such cases I think the transplantation of fat and skin will be of great help in making a more useful foot.

As far as the type of operation is concerned, I think the age of the patient has a great deal to do with what should be done. I think in a small child an operation on the soft parts is all that is necessary if the foot can be retained sufficiently long afterwards in casts or braces. In these cases usually we use a subcutaneous division of the plantar fascia and the internal scapho-astragaloid ligament, cutting towards the bone, making strong traction while doing so and then stretching the foot very thoroughly in an over corrected position. If there is very much equinus we only partially divide the tendo Achillis obliquely, stretch it thoroughly and put the foot up in plaster. That seems to give a good result. In older and relapsed cases of different varieties we have an entirely different proposition to contend with because the deformity has been present for a greater period. If we take the trouble to take a radiogram of these feet we shall find that the great bulk of that deformity is in the neck of the astragalus, that bone being the key-stone of the arch. The key-stone becomes broader at the top and naturally narrows the arch at the bottom. As long as we have this elongated neck or increased surface of the upper portion of the neck of the astragalus, it is almost impossible to correct these feet unless we do an osteotomy on the upper portion of the neck of the astragalus. If we take care to note in these cases that the os calcis, instead of running outward, tips upward very considerably at its anterior end, it would be not only unnecessary to do a tenotomy of the tendo Achillis, but would be harmful because we lose part of the stability in keeping the front part of the foot in the corrected position.

Another thing that is observed in doing this is that the cocked-up toes that have been present previously will straighten out and if the foot is retained long enough afterwards in the corrected position and a brace kept on, the toes will remain straight and the muscular action will be much better. These feet are usually shorter than normal feet. Taking out the small portion of the neck of the astragalus does not make the foot any shorter. It is astonishing to see how much power these muscles develop after operation. This, I think, is in part the operation that Dr. Hoke does extensively. It is surprising how much deformity the roentgenogram reveals in the astragalus in a club foot.

Dr. Walter Truslow, Brooklyn, N. Y.: The speaker has pointed out that the question before us is the principle of the operation. I would take the liberty of restating that principle. In my opinion it is a question between operating on the soft tissues primarily and the bone secondarily, on the one hand, or of operating on the bone primarily and the soft tissues secondarily. I am very much inclined to feel that in the correction of this and many other deformities of the foot, operation on the bone primarily and soft tissues secondarily is the correct procedure. As Dr. Riely has said, the astragalus is the guide to the situation; and by opening up (by whatever method you like) and so changing the structures, as Hoke has so markedly pointed out, we get the results that we want. Subcutaneous tenotomies of the plantar structures usually meet all muscle unbalance needs.

Dr. Charles A. Parker, Chicago, Ill.: I have been interested in Dr. Rugh's paper. It is just a revision of something that has gone before and then dropped out

and later been brought up again. I think there must be a very good place for it, especially in cases where the changes are just starting and we do not know what is best to do. They are not bad enough to do anything with and we might make them worse by operation. If we could interpose some tissue to stop the vicious process I think it might be worth while.

Before going on to the cases that have developed, I think what Dr. Truslow said is more to the point, shortening the bone and so relax the soft tissues in the vicious cases of hammer toe, bent toes, and retracted toes. There have been instances in which we have had to resect the heads of the first phalanges and the heads of all of the metatarsals, making ten and sometimes twenty operations necessary to straighten out the foot. On the other hand, in cases of very high arch and short foot I sometimes remove about 2 inches of bone in the tarsal region. I cannot elongate it, but by resecting the bone can make a very useful and not a very bad looking foot.

Dr. Charles Ogilvy, New York City: One would take for granted from this presentation that the original cause of the contraction was in the tissue itself. I hardly believe that that is the case, but that the contraction in most of the cases at least is a secondary condition. In some cases there may be an irritation causing contraction of the soft tissues, but as a rule the cause is not in the sole of the foot. If the contraction is relieved by a Phelps or similar operation there is no necessity of interposing tissue to prevent contraction, provided the after-treatment is properly carried out. I think the reason Dr. Rugh has had such good results is because the after-treatment has been so good. After a Phelps operation the scar is not contractile, and excellent results are obtained without the interposition of any tissue whatsoever.

Dr. James T. Rugh, Philadelphia, Pa. (closing the discussion): I am glad objection to the Phelps operation has been voiced. I want to emphasize several phases in which the Phelps operation is merely incidental. If the skin is not shortened it is not necessary to do the Phelps operation. I neglected to state in my presentation that I was not considering cases of true claw-foot. Those cases are absolutely bone cases and this operation will not suffice. I was considering the cases in which the soft parts only are involved. I always ask four questions: first, how long has the condition existed; second, what is the cause; third, is it primarily in the spinal cord or is it in the nerve trunks or is it in the muscles; fourth is it traumatic. I try to determine the cause if possible, because there is a primary cause for the contraction, and the secondary contraction which occurs is in the tissues unless there is traumatism or fibrositis or myositis. The type of deformity will determine the operation to be done. This is not a cure-all because it is absolutely useless where there are bone changes, but it does aid materially in lengthening the foot. You may combine with it any other operation you choose, such as tendon transplantation as recommended by Hibbs, as we have all done. You can do a resection of bone and you can do your arthrodesis so as to further stabilize the foot, but this, I feel, gives us one more sure hold on a foot that is otherwise extremely troublesome.

PERIARTERIAL SYMPATHECTOMY.*

BY ARTHUR KRIDA, M.D., NEW YORK, N. Y.

Assistant Surgeon to Out Patients, Hospital for the Ruptured and Crippled.

In 1921 Leriche[1] presented a paper before the American Surgical Association on his experience with an operation which he calls periarterial sympathectomy. His paper has stimulated a widespread revival of interest in a subject, certain essentials of which had been covered twenty-five years previously by his former chief, Jaboulay.

The operation consists in the removal of a cuff of adventitia from the main artery of the affected limb, and is based on the assumption that a large portion of the sympathetic nerve supply of the extremity accompanies the artery to its terminals. The conditions for which the operation is done and for which it is advised are those characterized by trophic derangements, angiospastic syndromes, and other indefinite states which are assumed to be intimately associated with a temporary or permanent change in the local circulation.

The effects of the operation as observed clinically are related primarily to an augmentation of the blood supply in the extremity distal to the site of operation. Following an initial period of vasoconstriction which lasts from two to ten hours, there is a period of active hyperaemia, increased local temperature, and subjective thermal sensations which may be demonstrated to persist up to two months after operation.

The generally accepted teaching of the physiology of the sympathetic system as advanced by Langley[2] denies that the sympathetic supply of the extremities follows the course of the larger arteries, but that it is incorporated in the spinal nerves, and that filaments are given off to the arteries at various levels from adjacent nerves. This, coupled with his somewhat unsatisfactory experience in six cases, is the basis of a critical paper by Callendar[3]. Lehman[4], likewise unable to reconcile the views of Langley with the clinical assumptions of Leriche, failed to produce the characteristic post-operative reaction in animal experiments.

There has, however, been accumulated in the Continental literature and in three further American papers, a fairly considerable mass of data, the general trend of which is in conformity with Leriche's experience. It must be remembered that a therapeutic measure, the indications for

*Presented at the Jan. 1924 meeting of the Orthopaedic Section, N. Y. Academy of Medicine.

which are so elastic, will be tried in cases that will later be eliminated from consideration. Also there is as yet but little data indicating the permanency of results. With these reservations, periarterial sympathectomy is advanced as a relatively safe procedure of real promise in unrelated groups of clinical entities in which treatment has hitherto been unsatisfactory or entirely without avail.

The following is a summary of sixty-seven case reports in the literature of the last three years, arranged according to clinical diagnoses and results. The sixty-four cases of Leriche[1] are difficult to tabulate and are not included in this summary. The reference number indicates the source from which the cases were drawn. Group 1 refers to cases that were symptomatically cured; group 2 that were greatly improved; and group 3 cases that were only slightly, or not at all improved.

Sixty-five cases are tabulated below: Case 66 is Sherwood's[6] case of arteriosclerotic gangrene in which the artery was accidentally wounded during the operation, and immediate amputation was done. Case 67[21] is a case of trophic ulcer of the foot in which periarterial sympathectomy was done on the external iliac artery. The artery was perforated, and the patient died of an infected hematoma on the seventh day.

	Group 1	*Group 2*	*Group 3*
Arteriosclerosis or Endarteritis Obliterans with Gangrene		3[6]	1[3], (Case 3)
		2[7]	1[3], (Case 5)
		1[8]	2[10]
		1[10]	1[6]
The same, with Claudication	1[5]		1[3], (Case 4)
The same, with Ulceration	1[3], (Case 4)		
	1[20]		
Trophic Ulcer of Foot	2[9]		1[3], (Case 2)
	1[10]		1[8]
	1[13]		
	1[17]		
	1[19]		
Trophic Ulcer of Stump	1[6]		
	1[8]		
	1[14]		
Leg Ulcers, Varicose and Similar Types	5[8]	3[8]	2[8]
X-Ray Ulcers		3[9]	

	Group 1	*Group 2*	*Group 3*
Diabetic Ulcer		1[8]	1[10]
Causalgia Syndromes	1[8], (Case 6) 9[15] 1[18]		3[15]
Angiospastic Gangrene			1[3], (Case 1)
Raynaud's Disease		1[12] 1[16]	
Ichaemic Paralysis of Leg			1[10]
Delayed Union, Fracture Tibia	1[8]		
Scleroderma		2[11] 2[16]	
	29	20	16

REPORT OF CASE.

S. C., Male, Age 53, Italian, a laborer.

First observation, March 1923, in the out-patient department of the Hospital for the Ruptured and Crippled. Service of Dr. Royal Whitman.

His history states that in October 1918, a five ton bucket fell on his right foot, crushing the toes. Infection followed promptly and the leg was amputated at the lower third one week after the injury.

In December, the stump was entirely healed.

August, 1919, he was supplied with an artificial limb, and soon after he began to wear this he developed an ulcer in the stump.

In December, 1919, a reamputation was done and the stump healed kindly.

In October, 1921, a second reamputation was done for a long standing recurrence of the ulceration. This reamputation was also followed by primary healing.

In October, 1922, the ulcer recurred. He states that since that time the ulcer has persisted and that there has been considerable pain associated with it. He states also that he is frequently awakened out of his sleep by "jerky spasms" about the knee. He has not worn his limb since October, 1922.

The examination in March, 1923, showed a rather bluish incompletely consolidated anterior flap amputation stump at the junction of the middle and lower thirds of the right leg. Posteriorly at the site of approximation of the flaps there were two dirty, sluggish, greyish ulcerations about three-quarters of an inch in diameter. The surrounding area was apparently very tender to pressure.

A roentgenogram showed that the bone ends were smooth and there was no evidence of infection in the bone.

He was sent home with instructions to rest the limb and to get systematic sunlight exposures to the stump.

In April, 1923, he again reported to the out-patient department and stated that he had faithfully carried out the sunlight therapy. It was evident from the appearance of the skin that he had done so, as it was very well tanned. There was, however, no change in the ulcerations, and it was therefore decided to do a periarterial sympathectomy on the femoral artery.

April 30, 1923, operation. Periarterial sympathectomy. A cuff of adventitia one and one half inches in length was removed from the artery.

May 18, 1923, he was discharged from the hospital with the stump entirely healed.

November 26, 1923, observation in the out-patient department reveals that the ulceration had remained firmly healed and that he has worn his artificial limb without pain since his discharge from the hospital six months previously. The stump appears well consolidated.

January 17, 1924, during the last three weeks there has been a slight recurrence of discharge at the site of one of the previous ulcerations and examination shows that there is a one half inch in length separation of the skin edges in the scar. There has also been a certain amount of pain associated with this recurrence.

Summary. An obstinate long standing ulceration of an amputation stump apparently due to insufficient nutrition. Healed in three weeks after operation and remaining firmly healed for seven months. Slight recurrence during the last three weeks. The result of the operation would have to be listed among the improved cases.

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UNUSUAL CASE OF FRACTURE OF THE FEMUR.

BY JAMES C. WILSON, M.D., HARTFORD, CONN.

E. W., age 16, male; born and brought up in the iron country in the mountains of Tennessee. On January 21st, 1922, he was sliding down hill when his sled ran into an automobile. When he was picked up, as he expressed it, "he picked his left foot out from behind his ear." He was examined very soon after the accident and a Thomas splint was applied. The swelling was very great and at one time I thought I would have to cut the ring of the Thomas splint. However, this did not become necessary.

FIG. 1
Plaster saw used to cut the graft.

FIG. 2
The fragment of bone 3⅝ inches long which was lost.

On January 26th a roentgenogram was taken, with the following report: A stereoscopic X-ray examination of the left thigh shows a badly comminuted fracture of the femur in region of its middle third.

The middle fragment, approximately three inches long, is split longitudinally, the larger half lying anteriorly and obliquely to the alignment of the femur. The lesser and posterior half is likewise obliquely placed but in the opposite direction. The proximal femoral fragment is displaced forward and to outer side, its distal end not in contact with the fragments."

FIG. 3
Roentgenogram before operation showing lack of alignment and position of the middle fragments.

FIG. 4
Roentgenogram three weeks after operation showing graft, posterior section of middle fragments, and beginning callus formation.

On February 2, 1922, a bone graft, seven inches long, was loosened up in the right tibia; an incision over the fracture was made in the left thigh and the larger of the middle fragments was found to be almost completely detached. This fragment, during the manipulation, came out and rolled down over the drapings and was therefore left out on account of the danger of infection. The bone graft was then taken from its place in the tibia and the upper end inserted into the medullary cavity in the proximal fragment and the lower end carried behind the distal fragment along the line of fracture, being fastened in place with No. 4 chromic catgut. The position of the graft was taken on account of the better alignment which it was possible to obtain in this manner.

The operation was performed with the leg in extension in the Thomas splint, thus necessitating no handling after the operation.

The patient was allowed to walk in five and one-half months and the fracture healed with less than one-quarter inch of shortening.

FIG. 5
Roentgenogram twelve weeks after operation showing extensive callus formation. Antero-posterior view.

FIG. 6
Roentgenogram twelve weeks after operation in lateral view showing the position of the graft and the alignment.

In cutting my bone grafts I have used for several years the old semi-elliptical plaster saw. This saw is very easy to handle, is used with a rocking motion, and, except where a gang saw is necessary, is very efficient. There is also very little danger of infection and none at all of burning the graft.

Roentgenograms were taken on February 23, March 13 and April 24.

CORRECTION OF BURN SCAR DEFORMITY BY THE Z-PLASTIC METHOD.

BY STEWART L. McCURDY, M.D., F.A.C.S., PITTSBURGH, PENNSYLVANIA.

Although the author had been operating by this method for several years previous, the first reports in the journals made upon this method appeared in 1902. A second article appeared in the Journal of Surgery, Gynecology and Obstetrics (February, 1913, page 209), and an article appeared in the International Journal of Surgery (December, 1917). Extensive reports will not be made, except to present a few cases illustrative of the method of operation, which has been called Z-Plastic Surgery. It is proper to state that it is difficult for surgeons to carry out this method, as they have told me, because the scheme of transferring flaps is not readily understood.

The method of operating upon burn scars across joints and in the region of the neck, which includes a cross section of the contracted part and suturing together of the lateral line of incision, so as to close as far as possible the denuded surface thus left, has been unsatisfactory for the reason that it did not remove the burn scar, which continued to contract after repair. Also the method of making an eyelet through the web, allowing it to heal and then severing the tissues from the opening to the edge of the web at a later stage, was not any more satisfactory than the transverse incision.

It occurred to me that the ideal method of treatment would be to implant in the center of the wound normal skin and to shift the burn scar to the ends of the field of operation. This method of operating was finally developed so that a perfect Z-incision is made as follows:

Split the burn scar from one end to the other at the crest. The two flaps thus made are dissected loose down deep into the tissues, even to the fascia over the muscles, where this is possible. The incision must be through the subdermal fat. Two incisions are now made from the two ends of this first incision, one to the right and the other to the left. The angle of these incisions to the first incision depends upon the part operated upon. A study of the illustrations will make this point clear. The points of these two flaps are now dissected loose, always remembering to preserve the subdermal fat with the flap, if this is found. The joint

is now extended and the flaps thus dissected loose very naturally drop into the denuded surface made by the extension of the extremity, or throwing backward of the head. It may be necessary to extend the lateral incisions farther out so as to permit the corners of the flap to drop back into the angles between the skin line. The corners of the flaps are now sutured in their new positions. It will be observed that the flaps cross each other in their adjustment to the new position, as shown in many of the illustrations.

In an effort to make the method clear I will show the web of my thumb, which would represent the burn scar across the neck or across any joint in the body. The first step in the operation would be to cut along the crest of the web of the thumb from one end to the other. These flaps are separated down through the tissue into the subdermal areolar tissue; that is, down to the fascia. Then a cut is made at a right angle from the distal end of this incision over the dorsum of the index knuckle for the required distance. The third cut is made at a right angle to the other end of the original cut, but on the opposite side; that is, around through the palmar skin of the thumb. This makes a Z-incision. The corners thus left are dissected up and freed throughout their entire length. If these corners are now grasped with hemostats and crossed one over the other, it will be found that they fit directly into the space left by this manoeuver, after the contraction is overcome by extension.

At this point it will be learned whether the end cuts have been made long enough to permit the flap to be transferred and properly fit into the angular space left by the transfer. When possible, these end right angle incisions should be made into normal skin, so that when they are adjusted the two flaps coming together in the center of the area will be composed of normal skin and the scar tissue will be shifted to the ends of the field. If it is found that the flaps are sufficiently free to permit a reasonable approximation of the skin lines, they are sutured in their new position.

A B

FIG. 1

FIG. 1. *A* shows burn scar under the arm. Operation by Z-method.

B shows result after complete repair. Observe the Z-line of incision across the axillary space.

A B

FIG. 2

FIG. 2. *A* shows neck cicatrix and ectropium of the lower lip corrected by the Z-method.

B shows the result after operation on another case. Contractions were very extensive, extending practically to the elbow. Observe the normal skin in the axillary space which was switched to this position from the chest wall.

FIG. 3

FIG. 3. Burn scar of the leg. *A* shows condition previous to operation. *B* and *C* show the case under treatment, about six weeks after operation.

A B C

FIG. 4

FIG. 4. Burn scar of the neck.

A. The Z-line shows the incisions. After these were made, flaps *A* and *B* were dissected loose back of the dotted lines. The second step in the operation is to take flap *B* and switch it over into the space left underneath the mandible on the left side after dissecting loose flap *A*.

B. Flap *A* is drawn downward and below flap *B* and sutured in its new position. It will be observed that originally flap *A* was attached to the symphysis, but finally was sutured to the skin immediately over the sternum; and that the angle of flap *B*, originally attached to the skin immediately over the sternum, was shifted so as to be sutured to the skin immediately under the left angle of the mandible.

C shows the final result. This operation was performed twenty years after the original burn. Notice in *C* there is no traction upon the angle of the mouth; the face has assumed an entirely different expression, and the neck line is perfect throughout the entire circumference.

A B C

FIG. 5

FIG. 5. *A* shows a burn scar completely filling the angle of the neck from the tip of the chin to the sternum.

B shows the result after the first operation.

C shows the line of incisions. Observe the Z-arrangement of the wound.

D E

FIG. 6

FIG. 6. *D* and *E* show the final result in Fig. 5 after the second operation. Observe the complete extension of the head in the first figure and the graceful neck line in the second.

FIG. 7

The case shown in Fig. 7 had her first operation in December, 1921. The result of this operation and another in January, 1922, is also shown. Since that time four more operations have been performed.

The method of the first operating in this case is represented by the lines shown in the figure. This included incisions from the center of the clavicle downward and inward to the center of the sternum, as will be observed from the scars shown in subsequent pictures. This great area of skin was dissected loose down to the bone itself and the head freed and thrown backward. The lateral flaps represented as *A* and *B* were brought together in a median line, as will be seen in subsequent pictures. The area of denuded surface left over the region of the clavicle was closed by bringing the skin up around the neck and over the shoulder together as nearly in the median line as possible. The skin, which appeared to be so extensive, represented in the first illustration, and quite sufficient to cover the neck and chin, shrunk until what is left of it is shown over the chin in the second picture. The burn scar extending from the chin to the sternum was removed only after a regulation Z-operation was done.

The present condition is shown in Fig. 8. Observe the normal skin across the neck midway between the chin and sternum, guaranteeing that there can be no further contraction.

FIG. 8

A METHOD FOR THE CORRECTION OF PARALYTIC GENU RECURVATUM.

Report of a Bilateral Case.

BY CLARENCE H. HEYMAN, M.D., CLEVELAND.

From the Orthopaedic Department of Mt. Sinai Hospital, Cleveland, Ohio.

The results obtained by the writer in the operative correction of a case of a severe bilateral genu recurvatum as a result of infantile paralysis prompt him to report the method used. A brief discussion of the anatomy of the knee joint pertaining to hyperextension or recurvatum will make the rationale of the operation clear.

When the articulating ends of the femur and tibia are examined in the skeleton one is struck by the apparent insecurity of the knee joint, because the bony surfaces show little adaptation the one to the other. It owes its great strength to the muscles and ligaments. The curve of the femoral condyles, when viewed from the side, is that of a spiral. The posterior part consists of an arc of a circle with a smaller radius than the anterior part, which is relatively flat, and accounts for the gliding forward of the tibia at the completion of extension. Observations on knee joint preparations have shown that the last five degrees of extension consists of external rotation of the tibia, limited by the two lateral ligaments, together with a slight gliding forward, limited by the anterior crucial ligament. Hyperextension of the knee, then, is limited by the anterior crucial ligament, the internal lateral ligament, and the external lateral ligament. Lateral mobility is allowed in no position of the knee, and is prevented by the lateral ligaments.

Not willing to assume the responsibility of subjecting the patient to the grave operative procedure of attempting to shorten the anterior crucial ligament by means of the Hey Groves operation, it was decided to attack the problem by working on the extra-articular structures resisting hyperextension. Useful lateral ligaments can be constructed, as shown by Edwards and Wilson. If, at the same time, their attachments could be altered to function more decidedly as a check to hyperextension, the problem may be solved.

It will be seen in a diagram (Fig. 1) of the lateral surface of the knee with the external lateral ligament attached, that hyperextension or recurvatum is restricted by the external lateral ligament, represented by

A–B. Recurvatum would necessarily increase the distance from the two points of attachment on the femur and the head of the fibula. If the upper attachment were transplanted even farther posterior, as at C, this resistance to recurvatum would be still more decided, and would be impossible without an actual tearing or stretching of the resisting band.

Fig. 2 represents a diagram of the medial aspect of the knee with the internal lateral ligament represented by A–B. By constructing a new

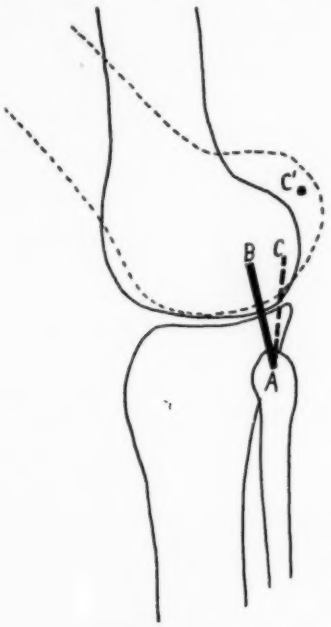

FIG. 1

The external lateral ligament is represented by the heavy line A–B. The interrupted line, A–C, represents course of the new band constructed.

C′ represents the attachment C with the knee in recurvatum, which would be impossible if the band holds.

band of fascia with the upper attachment more posterior and the lower attachment more anterior, represented by C–D, a still more definite check to recurvatum may be obtained, and would again be impossible without an actual tearing or stretching of the band.

It occurred to the writer that if strong bands of fascia could be constructed with attachments as indicated above, recurvatum would be prevented. We have reason to believe that strong muscle tendons and

strong bands of fascia hold remarkably well and more or less permanently, as Gallie has shown. Moreover, if there are not serious mechanical factors at work to reproduce the deformity, other structures, like the posterior capsule of the joint, will have a chance to contract and help to prevent a recurrence.

To construct these bands the principle of the Edwards operation for reconstruction of the lateral ligaments is used. Whereas the Edwards

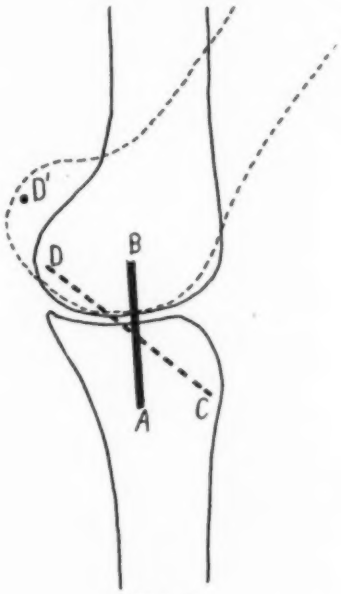

FIG. 2

The internal lateral ligament is represented by the heavy line A–B. The interrupted line, C–D, represents the course and attachments of the new band constructed. D′ represents the attachment D with the knee in recurvatum which would be impossible if the band holds.

operation aims to construct bands with attachments at the normal sites of attachment of the lateral ligaments, the modification proposed consists of securing the femoral attachment as far posterior on the femoral condyles as possible, and on the medial side to obtain an anterior attachment on the tibia.

Through a longitudinal incision over the lateral aspect of the knee, the biceps tendon is exposed and divided just above the level of the joint.

In case the biceps muscle is not paralyzed, a longitudinal flap is raised instead of severing the whole tendon. A rectangular flap of fascia lata about 3 inches long is made, with its base at the femoral condyle as far posterior as possible, and the flap is folded to make a strong narrow band. The knee is then flexed to an angle of about 110 degrees, and the proximal end of the distal segment of the biceps tendon is attached by means of a small staple in a groove prepared on the femoral condyle as far posterior as possible. The band of fascia lata is similarly secured into the head of the fibula, maintaining in both instances strong tension while fixing. The deep fascia is then sutured over, and the wound is closed.

A longitudinal incision is then made over the medial aspect of the joint, exposing the gracilis and semitendinosus tendons. These tendons are divided just above the level of the joint, and by blunt dissection they are freed to their insertion well around to the anterio-medial surface of the tibia. A groove is prepared on the medial condyle as far posterior as possible, and the proximal ends of the distal segments of the tendons are secured under strong tension similar to the method on the other side. The free ends of the gracilis and semitendinosus tendons are then sutured to the sartorius muscle, which is pulled well backward by means of sutures to the deep fascia. It will be observed when the bands on both sides have been secured that there is a decided resistance to extension of the knee and that there is no lateral mobility.

The knee is immobilized in flexion at an angle of about 110 degrees by means of a plaster bandage which is removed six to eight weeks later. The after treatment consists of gentle physical measures to obtain extension of the knee. After two operations performed by the writer the knees could not be extended beyond 135 degrees immediately after the removal of the plaster.

REPORT OF CASE

H. V., a boy aged eleven years, had infantile paralysis when four years old. He was first examined at the Mt. Sinai Hospital in January, 1922. Unfortunately no photograph was made. He presented the following findings: Most severe bilateral genu recurvatum, more marked on the right side, with a marked degree of lateral mobility in both knees. There was a moderate contracture of the Achilles tendons with a fairly well marked paralytic valgus. There was apparently a complete paralysis of both tibialis posticus muscles, and only fair tibialis anticus muscles. The extensors of the toes and the peronei were good. Both quadriceps muscles were decidedly weakened, although he was able to extend both knees against gravity. The knee flexors were also very weak, and there was a complete paralysis of the right biceps. He was able to flex the left knee against gravity with slight resistance, and was barely able to flex the right knee against gravity alone. The hip muscles were good except for weak hip flexors.

The recurvatum was evidently caused by a combination of the contracted Achilles tendons with the weakened hamstrings.

On February 11, 1922, a triple arthrodesis of the tarsal joints of both feet was done, followed later by tenotomy of the Achilles tendons. Very satisfactory stable feet were obtained, and he was supplied with braces to prevent recurvatum at the knees.

FIG. 3

Shows genu recurvatum of the left knee before operation. The right knee, which was operated on five months before, showed even greater recurvatum.

He was examined at regular intervals up to July, 1923. At this time his braces were in need of repair, and he came into the out-patient department walking on crutches, without his braces. The feet were stable, and there was no recurrence of the contractors of the Achilles tendons. Other physical findings were as before. It was considered a favorable case on which to attempt an operative correction of the recurvatum, since

perhaps the most important cause of the production of this deformity had been corrected. Accordingly, on July 21, 1923, the knee with the more severe deformity was operated on by the method described above. The plaster was removed six weeks later, and to all appearances the knee was in a position of flexion contracture. Flexion was possible beyond 90 degrees, but the knee could not be extended beyond 130 degrees. Massage and gentle manipulations were inaugurated to obtain complete extension. After four

FIG. 4
Ten months after operation on the right knee, and five months after operation on the left knee.

weeks, extension was not possible beyond 160 degrees, and the advisability of wedging was seriously considered. However, three weeks later the knee could be extended to 180 degrees. Lateral mobility had been completely overcome. No brace was ordered. He was examined again five months later. In the meantime he had been walking every day, attending school, using only his crutches, and bearing his full weight on the operated

leg. The knee could be extended just short of complete extension, and there was no lateral mobility. (Fig. 3.)

On December 31, 1923, a similar operation was performed of the left knee, which reacted in a similar way; i. e., approximately six weeks elapsed after the removal of the plaster before satisfactory extension could be obtained.

The present condition, May, 1924, (Fig. 4) shows complete extension of the right knee possible, but no recurvatum. There is a very slight lateral mobility. Extension of the left knee is possible to about 185 degrees, and no lateral movement is possible.

COMMENT.

Although, undoubtedly, a sufficient length of time has not elapsed to form a definite opinion as to the permanency of the results, it is most encouraging to note that the deformity in both knees has been overcome. Further observation will, of course, be necessary, and a larger number of operations must be performed before definite conclusions can be reached as to the value of this procedure. It appears to be a rational one in cases in which the mechanical factors tending to reproduce the deformity have been overcome. It, of course, is contraindicated in cases of paralysis of the quadriceps. The operation has great advantages over supracondylar osteotomy or an arthrodesis, which certainly could not be recommended in bilateral cases. It has a distinct advantage in that the joint is not opened, and that in case of failure no harm is done, as the patient could not possibly be worse off than he was before operation.

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TRACTION FRACTURE OF THE LESSER TROCHANTER

BY IRVIN BALENSWEIG, B.S., M.D.

Clinical Instructor, Orthopaedic Surgery, Cornell Univ. Med. College; Asst. Surgeon, Hosp. for Ruptured and Crippled, Out-Patient Dept.; Assistant Visiting Surgeon, City Hospital, New York City.

The rarity of this condition prompts the writer to add five additional cases to the thirty-three reported instances in the literature, making a total to date of thirty-eight.

Prior to 1908, there appeared four reports, the earliest being that of Brunelle, in 1854. Since that time, (1908) due to the greater use of the Roentgen ray, the condition has been more frequently recognized and reported.

This paper deals only with instances of uncomplicated fracture of the trochanter minor, as fracture complicating other injuries is not an uncommon occurrence.

APPLIED ANATOMY.

The epiphysis appears between the eleventh and thirteenth years, and fuses with the shaft about the eighteenth year.

"Flexion movement at the hip joint, whether of the thigh on the trunk or of the trunk on the thigh, is performed by the iliacus and psoas magnus muscles. The psoas is a long and powerful fleshy muscle arising within the abdomen on each side from the lumbar vertebrae. It is traced ventral to the sacro-iliac articulation, and coming into relation with the iliacus passes with it beneath Poupart's ligament, and is inserted by a tendon into the lesser trochanter of the femur. The iliacus, also a strong fleshy muscle, arises within the pelvis from the iliac fossa and the base of the sacrum. It is traced with the psoas beneath Poupart's ligament to be inserted partly into the tendon of the psoas, partly into the lesser trochanter, and partly into the femur, for about one inch, immediately below the trochanter." (The combined action of the muscles is one of pure flexion, as we can bend the thigh in the position of either internal or external rotation. Morphologically considered, the psoas major muscle is distinctly a late development due to the acquiring of the erect position by man. In the mammalia the psoas major is comparatively an insignificant one, whereas the psoas minor is a relatively large one.) "The erect position in man has necessitated powerful

muscles for support about the centre of motion of the body, which is at the hip joint. The development of powerful extension function has called into being powerful flexion." (Mackenzie, W. C.—The Action of Muscles. Hoeber, 1918.)

THE LITERATURE TO DATE.

Year	*Author*	*Age*	*Sex*	*Side*	*Reference*
1854	Brunelle	19	Male	Right	Rev. med. chir. de Paris, 1854–xvi, 57.
1879	Juilliard	82	Male	Right	Progrès méd., 1879, vii., 825.
1893	Hutchinson	17	Male	Right	British Med. J., Dec. 30, 1893, 671.
1904	Bardenheuer	15	Male	Right	Ueber die Behandlung der Frakturen, 1904.
1908	Picquand Douai	87	Male		Bull. et. mem. Soc. anat. de Paris, lxxxiii, 486.
1909	Pochhammer	15	Male	Right	Arch. f. klin. chir., 1909–10, xci, 719.
1909	Hannemueller	18	Male	Left	Beitr. z. klin. Chir., 1910, lxx, 905.
1909	Hoch	17	Male	Left	Ztschr. f. Chir., 1910, xcvii, 405.
1909	Chaput	52	Male	Left	Bull. et mem. Soc. de chir. de Paris, xxxv, 207.
1911	Binet Hamant	11	Male	Left	Rev. de Chir., 1911, xliii, 564.
1911	Martius		Male		Münch. med. Woch., Bd. 58, xx, s. 2636.
1911	Bähr	16	Male	Left	Deutsch. med. Wchnschr., 1911, xxxvii, 1942.
1911	Grune	14	Male	Right	Ztschr. f. orthop. Chir., 1911, xxix, 80.
1912	Naegeli	14	Male	Left	Beitr. z. klin. chir., 1912, lxxvii, 242.
1912	Peggar	52	Male		Beitr. z. klin. chir., 1912, lxxxi, 138.
1912	Vorschutz	14	Male	Right	D. Ztschr. f. Chir., 1912, 117, s. 243.
1912	Wagner	14	Male	Right	D. Ztschr. f. Chir., 1912, 117, s. 557.
1912	Gray		Male		Jour. Roy. Army Med. Corps, London, xviii, 578.
1914	Wolbaum	15	Male	Right	D. Ztschr. f. Chir. 1914, 128, s. 139.
1914	Wolbaum	12	Female	Left	D. Ztschr. f. Chir. 1914, 128, s. 139.
1914	Metcalf	17	Male	Right	J. Am. Med. Assoc., 1915, lxiv, 1234.
1914	Metcalf	16	Male	Left	J. Am. Med. Assoc., 1915, lxiv, 1234.
1916	Ross	15	Male	Right	Ann. Surg., 1917, lxv, 241–245.
1920	Ruhl	17	Male	Left	Bruns Beitr. z. klin. chir., 1920, 118.
1920	Usland				Medinsk. Rev., October 1920.
1920	Poston	14	Male	Right	Brit. J. Surg., 1921–22, lx, 256–58.
1921	Eikenbary	7			J. Othop. Surg., 1921, iii, No. 9.
1921	Eikenbary	11	Male		J. Orthop. Surg., 1921, iii, No. 9.
1921	Eikenbary	13			J. Orthop. Surg., 1921, iii, No. 9.
1923	Heath	15	Male	Right	Proc. Roy. Soc. Med.; Lond., 1923, xvi, No. 5. Sect. Orthop., 12.
1923	Pugh	14	Male	Left	Proc. Roy. Soc. Med., Lond., 1923, xvi, No. 5. Sect. Orthop., 12.
1923	Langdon	12	Male	Right	Surg. Gynec. and Obst., 1923, xxxvi, No. 4, 556.
	Carthy	8	Female		Reported by Naegeli, no reference given.

ETIOLOGY.

1. Age incidence of the reported cases, together with the writer's cases.

Age	*No. of Cases*	*Percentage*
Between 1 and 10	2	5.7
Between 10 and 20	29	82.8
Between 20 and 60	2	5.7
Between 60 and 100	2	5.7

Of the entire number of cases, two females were reported suffering from the above mentioned condition. There were fifteen instances affecting the trochanter minor on the right side, and eleven on the left side.

The causative agent is primarily one of sudden strain on the lesser trochanteric epiphysis exerted through the ilio-psoas muscle.

SYMPTOMS.

The injured person is usually able to walk about unassisted, but with a limp, the thigh being held in slight flexion, adduction or abduction, and rotated outward. Pain is always an accompanying symptom when walking.

With the patient on an examining table, swelling, ecchymosis and point tenderness in the region of the lesser trochanter are only occasionally observed, whereas Ludloff's sign is always found, and is pathognomonic. (With the patient in the recumbent position, partial flexion of the extended limb may be possible due to the action of the tensor fasciae femoris and rectus femoris muscles, but when in the sitting posture this action cannot be performed.) Passive movements can be carried out in all directions; extension and abduction, however, may be partially restricted and painful.

In the elderly, suffering from fracture of the lesser trochanter, the symptoms simulate those of fracture of the neck or the femur, and as such have been formerly treated.

REPORT OF AUTHOR'S CASES.

Case 1. J. H.; Age 16; Schoolboy. During the act of running on September 29 1923, was seized with a sudden pain in the left groin. Did not fall to the ground but had to stop running. Since then the pain has persisted and patient has been walking with a decided limp.

EXAMINATION. Boy is in good general condition; walks with the aid of a cane, with the body tilted towards the left side and anteriorly. All motions of the hip joint are free, except flexion, which was impossible to perform. Passively, all motions were obtainable, extension, however, being painful. There were no points of tenderness

FIG. 1
(Case 1) October 4, 1923. Displacement of epiphysis of lesser trochanter upward and slightly inward.

either anteriorly or posteriorly. No discoloration nor swelling. Measurements equal, both in length and circumference.

DIAGNOSIS. Fracture of the lesser trochanter, confirmed by Roentgenogram.

TREATMENT. Short plaster of Paris spica applied, with the hip slightly flexed and abducted. On November 1st, the plaster was removed, examination showing complete recovery.

Case 2. G. S.; age 16; schoolboy. November 16, 1923, while playing football and running backwards, stopped suddenly in an attempt to catch the ball. This necessitated a lunge to the left, with the left leg on the ground and rotated inward. Felt sudden pain in the left hip; however, continued to play. The same evening while playing "kick the

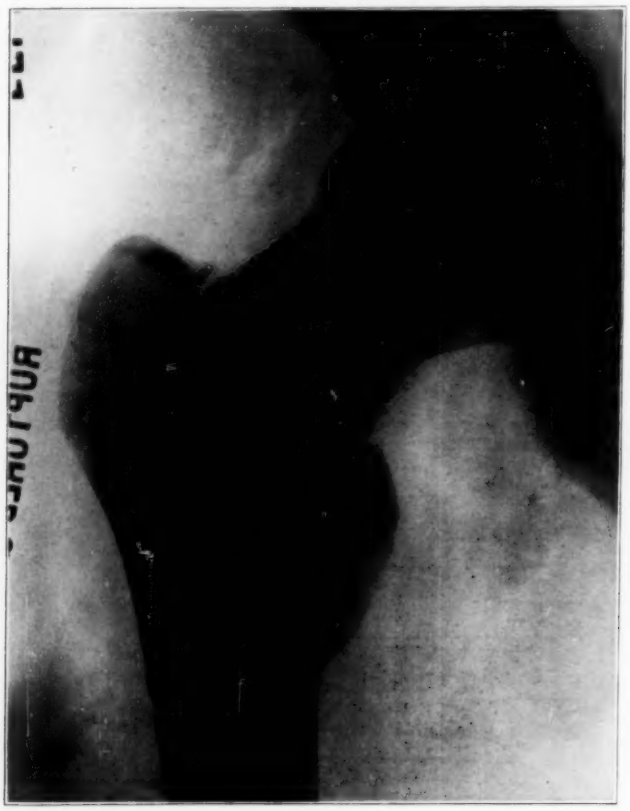


FIG. 2
(Case 1) November 24, 1923. Union of opposed surfaces.

hoop," on kicking the hoop forcibly with the left foot, suffered a recurrence of pain and this time had to be assisted home. Walked into Clinic, twenty-four hours later.

EXAMINATION. Patient walked unassisted with a decided left hip limp, with the limb slightly rotated outward. There was voluntary motion in all directions, except that of flexion, this being impossible, both in the supine and sitting positions. There were no points of tenderness, no swelling nor discoloration. Limbs were of equal length. No atrophy present.

Diagnosis. Confirmed by Roentgenogram.

TREATMENT. An adhesive plaster hip strapping was applied, so that the patient could be demonstrated before the Alumni Association of the Hospital for the Ruptured and Crippled, which was to meet the following week. On presenting the patient, it was observed that he could now flex the thigh to one-quarter the normal degree, both in the

FIG. 3

(Case 2) Nov. 17, 1923. Displacement of epiphysis as in Case 1.

recumbent and sitting positions, and complained of no pain. No further treatment was instituted, and when last seen (December 15th) four weeks after injury, patient had completely recovered.

Case 3. H. E.; age 15; male; student. Was seen by Dr. Zadek at the Hospital for Ruptured and Crippled on September 1, 1923, complaining of difficulty in walking.

HISTORY. While playing ball two days ago, patient slipped and fell, striking the left side of his body. Was unable to rise, and therefore had to be assisted to a resting place. Later in the afternoon, he walked home.

EXAMINATION. Patient is in good condition, walks with a limp on the right side, with a tendency towards slight external rotation and abduction. As he lies on the table,

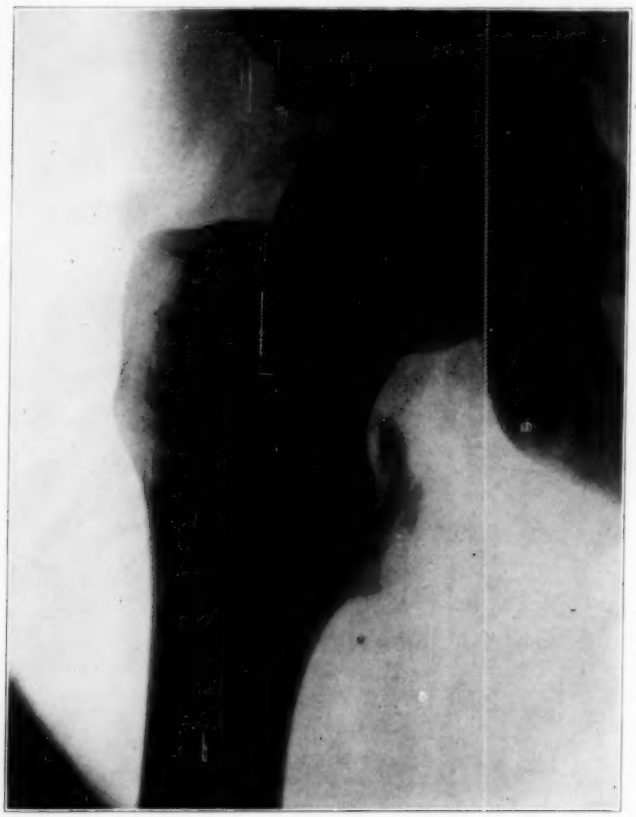


FIG. 4
(Case 2) Dec. 15, 1923. Early union.

movements of the affected hip are free. There is local tenderness at the site of the lesser trochanter. He is unable to flex the thigh, although this can be performed passively.

Diagnosis confirmed by roentgenogram.

TREATMENT. Application of plaster spica with relief from symptoms. Complete recovery on removal of plaster five weeks later.

Case 4. E. A.; male; age 14; student. April 15, 1921. Seen by Dr. T. Nicola at the Hospital for Ruptured and Crippled, with the following history: A few days ago patient fell while skating, since then has been complaining of pain in the right groin.

Examination shows that the motions at the hip joint are slightly restricted and voluntary flexion is impossible. There is no localized point of tenderness. Radiogram advised, and this revealed the presence of separation of the epiphysis of the lesser trochanter, both upward and inward.

TREATMENT. Plaster spica applied, remaining on for a period of four weeks. Removal of plaster followed by complete recovery.

Case 5. R. F.; age 14; male; schoolboy. Case of Dr. B. H. Whitbeck seen on November 14, 1923, with the following history: Four days ago, during a football scrimmage, patient suffered acutely from pain in the right groin, and had to be assisted off the field. Examination showed swelling of Scarpa's triangle, slight external rotation and tenderness over the region of the lesser trochanter. Treatment — Plaster of Paris spica applied, with the limb in flexion and slight adduction. Complete recovery, following removal of plaster five weeks later.

SUMMARY.

The outstanding points of interest elicited from both the literature and cases herein reported are: The presence of the lesion in boys between the ages of ten and twenty; the diagnostic sign, that of loss of flexion and the rapidity of cure as a result of conservative therapy.

Cases No. 1 and 2 were presented before the Alumni Association of the Hospital for Ruptured and Crippled on November 26, 1923.

The author wishes to acknowledge his indebtedness to those who have assisted him in the collection of the cases herein presented.

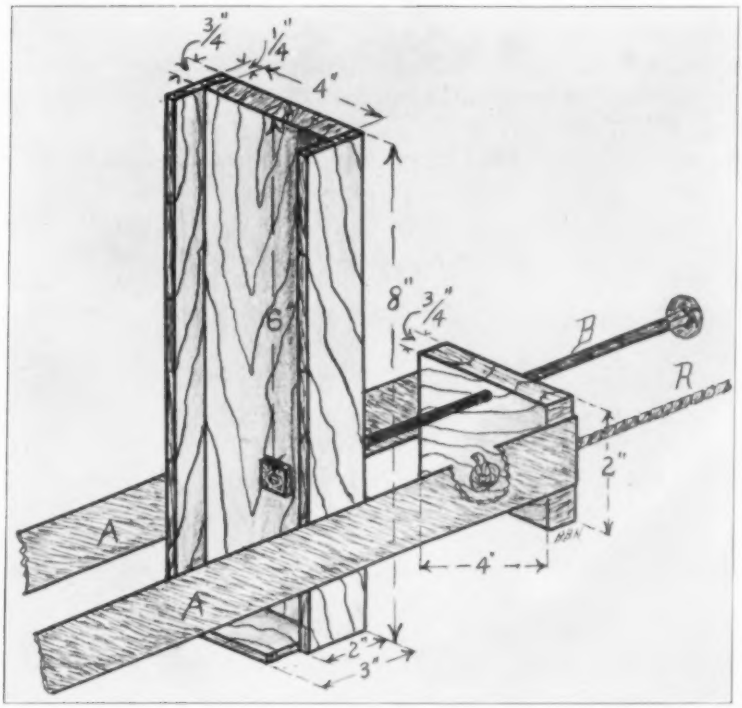
A SIMPLE APPARATUS FOR PREVENTING TOE-DROP.

BY BERLIN B. NICHOLSON, M.D., UNIVERSITY OF VIRGINIA HOSPITAL, UNIVERSITY, VA.

In the treatment of orthopaedic cases which demand extension applied to the legs, toe-drop is a condition which must always be guarded against. This is especially true in cases which must be kept in extension for several weeks. Where plaster-of-Paris casts are used as a splint this condition can be avoided by properly including the foot in the cast. In a certain number of cases, however, it is not always convenient or advisable to use plaster casts. In these cases toe-drop must be combated by some other means. Probably the most common method is to pass a strip of adhesive over the ball of the foot and fasten the ends to the leg near the knee. Large rubber bands applied in this same manner are probably more satisfactory and more comfortable to the patient. At best these methods are quite unsatisfactory for several reasons, chief among which is the failure to accomplish the purpose for which they are applied. As the adhesive straps, through which extension is applied to the leg, slowly slip on the skin the apparatus holding up the toe must be reapplied frequently in order to have it effective. Often it is next to impossible to keep the straps adjusted so that they are effective and at the same time comfortable to the patient.

The apparatus illustrated in the accompanying drawing is simple to make, effective in preventing toe-drop, easy to keep adjusted to the foot and is quite comfortable to the patient. The drawing is almost self-explanatory. The foot-piece is a piece of ordinary three-quarter inch board, four inches wide and eight inches long, with a two inch strip tacked to each side and a three inch one to the bottom. These strips are intended to keep the foot in place. The rod (B) is an ordinary six inch carriage bolt, which is fastened securely to the foot-piece by means of two taps, one on each side of the board. The small block (two inches by four inches) serves as an attachment for the adhesive straps (A), which are adherent to the lower leg, and also, as a point of attachment for the rope (R) which is carried over a pulley at the foot of the bed, and at the end of which the desired weight is suspended. The hole in this block through which the stove bolt (B) passes is of such size that it will permit the two to slip easily upon each other. The position of this hole and that

through which the rope (R) passes is the essential feature of the apparatus. Each is placed about three-eighths of an inch from the edge of the block. By having them so placed there is sufficient side-thrust to lock the bolt; the greater the weight applied at the end of the rope (R) the tighter the lock. Pressure of the toes and the ball of the foot against the upper end of the foot-piece also tends to increase the lock. To still further increase the lock it is essential to have the adhesive straps applied as near the upper edge of the block as is possible. That portion of the adhesive strap which is in contact with the apparatus should be faced with another piece of adhesive to prevent adherence to the side of the foot-piece. The foot-piece is easily adjusted by simply pushing against the head of the bolt (B) while the traction weight is being supported. As soon as the weight is allowed to act again the apparatus is locked in proper adjustment.

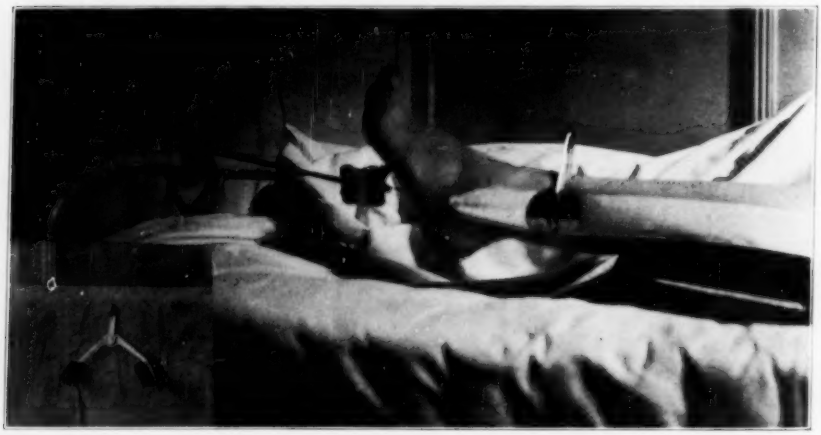


A WISH-BONE CLASP FOR RETAINING EXTENSION STRAPS

BY G. T. TYLER, JR., M.D., GREENVILLE, S. C.

One of the difficulties attending the use of extension straps when applied to the leg is the pulling away of the straps just above the ankle. Adhesive plaster or a bandage at this point may constrict, or stretch, being efficient for only a short time. To overcome this difficulty, I have devised a 'wish-bone' clasp with movable blades attached to hold the lateral straps against the skin immediately above the malleoli. Since no important vessels nor nerves lie along the bones in this region, injury is not likely. Pressure can be controlled, and adjustment easily made at the joint of the clasp, giving pressure only sufficient to overcome the pulling away by the weights. I have used this clasp on several patients with satisfactory results. A pad of cotton may be applied if necessary to prevent too great a pressure. It must be watched to prevent slipping.

Dr. W. S. Baer, of Baltimore, suggested that the blades be made smaller, which was done with improvement to the apparatus.



Two views of the clasp.

The photographs illustrate the use of the clasp. The arms measure 12 cm. in length, 1 cm. the greatest width, 0.4 cm. least width; in thickness, 0.2 cm. The lever locking the joint holds by friction. The blades measure 5.5 cm. by 4.5 cm., and are slightly curved as in the illustration. They are attached by wires passing through holes in the arms, and riveted to them (blades). This permits a rocking of the blade to adjust itself to variations in the shape of the leg. The clasp can be applied to the arm as well.

FRANK E. PECKHAM, M.D.

Members of the American Orthopedic Association received with deep regret the announcement of the loss of one of their esteemed members, Dr. Frank E. Peckham, who died at his home in Providence, Rhode Island, on March 9th, 1924, after a brief illness.

Dr. Peckham was born on May 13th, 1862, at Hopkinton, Rhode Island, and received his degrees at Brown University, Ph.B., 1885, and Harvard Medical School, M.D., 1890. After serving an interneship at the Boston Children's Hospital, he went at once to Providence and there has held a prominent place in the profession and has filled many important positions. Dr. Peckham served as Orthopaedic Surgeon at the Rhode Island Hospital from 1895 until 1913, and at St. Joseph's Hospital from 1904 until his death in 1924. He was consulting Orthopaedic Surgeon to Memorial Hospital, Pawtucket, R. I., and to the Woonsocket Hospital, Woonsocket, R. I.

After completing his service at the Children's Hospital, where he had begun his orthopaedic training, Dr. Peckham at once went to Providence and established himself in that community, and there became a pioneer in his chosen specialty. The part played by these men who begin alone in their chosen field and work calls for a testimony of appreciation and a recognition of their courage and persistency in surmounting the tasks, as well as the discouragements, which beset them in the early periods. By his early endeavors, he brought to the community a recognition of his specialty, and the work which he began has now grown to large proportions. It is established in three hospitals, and Providence now stands as an efficient centre for orthopaedic work.

Dr. Peckham always had a directness of aim and action, and he was so directly opposed to pretense that he may have seemed critical to some, but his criticism was always directed toward an emphasis of the truth, and he sometimes seemed to be leading a crusade against veneer, whenever he felt that such existed. This honesty of purpose led to persistency in attention to careful detail in his cases and to an accurate estimate of his results. During the last years of his life, Dr. Peckham devoted much time to the treatment of the more difficult types of fractures, and particularly those which were benefited by accurate mechanical appliances. Although he recognized and emphasized the value of mechanical treatment, he in no way failed to appreciate the importance of the

operative features of the treatment of these and other orthopaedic conditions. He combined the rare qualities of a skillful surgeon and a good clinical mechanician,—two qualifications which are necessary for the successful treatment of orthopaedic cases. He also recognized that those two qualities should reside in the same individual; that the treatment of cases should not be divided because of the lack of either. This stand which he took so strongly has done much to place orthopaedic surgery on a sound surgical basis, and the part he played is appreciated by all of his friends who knew him well.

Dr. Peckham is survived by his wife, Alice Fancher Peckham, and their one daughter.

SIR WILLIAM MACEWEN, C.B., M.D., F.R.C.S., F.R.S.

REGIUS PROFESSOR OF SURGERY, UNIVERSITY OF GLASGOW.

Sir William Macewen died in Glasgow on March 22nd of this year after a short illness. A full account of his career, of his attainments, his contributions to science, and of the honors which fell to his lot, have already appeared in the medical journals of many countries. Macewen was one of the last remaining "general" surgeons in the old sense of the term. In his long hospital service covering a period of forty-seven years he illuminated with the skill of a master almost every surgical field in turn. To those surgeons whose chief absorbing interest lies in the problems to which the Journal of Bone and Joint Surgery is devoted, the classical experimental work of Macewen on bone growth with all its possibilities of variable interpretation has come to represent almost a fundamental article of faith.

Sir William was an honorary member both of the American and British Orthopaedic Associations, and this brief notice represents in some measure the sense of loss which the members of the two bodies feel.

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, JANUARY 31, 1924.

THE PRESIDENT, DR. KRIDA, IN THE CHAIR.

DR. ROYAL WHITMAN—Operation for Obstetrical Paralysis and Dislocation.

The patient, a boy of 13, presented a typical deformity the result of obstetrical paralysis of the left upper extremity—namely subluxation of the head of the humerus, inward rotation of the arm, pronation of the forearm and atrophy of the shoulder muscles. The deformity was so resistant that an open operation was performed on September 17, 1923. The pectoralis major, the subscapularis insertions were divided, also the coraco brachialis and latissimus dorsi, and a plaster support was applied in the corrected attitude. The plaster was reapplied a month later and since that time he had been under treatment in the massage department. The deformity has been corrected and a few degrees of voluntary motion at the shoulder have been restored.

DR. JOSEPH HOGUET—Pathologic Fracture, Neck of the Femur: Reconstruction operation.

The case presented by Dr. Hoguet was a young Russian, 32 years old. Personal history unimportant except that he contracted syphilis at the age of eighteen for which he apparently had very intensive courses of treatment in a number of the German clinics. In 1920 he had what was presumably a meningeal syphilis with an attack of unconsciousness which lasted ten days and for which he received treatment in Germany. The present illness dates from December 14, 1923, when he presented himself with the history that for the last ten days he had some pain in the left hip joint which did not radiate down the leg. On examination at that time the motions in the hip joints were normal, there was no shortening of the leg, and very slight tenderness over the hip joint. On December 22, 1923, while walking in the street, his left leg suddenly gave way under him and he fell to the ground. He was carried home and the following day brought to the Ruptured and Crippled Hospital where a roentgenogram was immediately taken and he was found to have a fracture of the head and neck of the femur. This roentgenogram also showed a number of irregular shadows around the neck of the femur. A blood Wassermann test at this time was found to be negative. There was about an inch and a half shortening in the left leg and all the typical signs of a fracture in the neck of the femur. An operation was performed on December 27, 1923, a typical reconstruction operation being done with the removal of the head, which was found loose in the acetabulum, the round ligament having disappeared and the cartilage over the head of the femur practically entirely destroyed. He was put in a large plaster of Paris spica. During the operation both arms were extended over the head, and when he recovered from the anesthetic he was found to have a complete motor and sensory paralysis of both arms. He was kept in the hospital about four weeks, during which time motions became practically normal in the right arm and recovered to some slight extent in the left. The plaster of Paris was removed at his home after about eight weeks. I examined him March 1, 1924, and found that he had a fairly good range of motion in all

directions at the hip joint and a good deal of crackling was found on motion in the joint. His physician reported to me on April 12, 1924, that motion has improved in every direction. The leg could be raised from the bed to an angle of about forty-five degrees, but the crackling in the joint had increased and could be heard at some distance from the patient. The diagnosis now seems to be Charcot's Disease of the hip joint.

. Dr. Richmond Stephens—Acute Tuberculosis of the Knee Joint: Treated by Arthrotomy.

Patient presented by Dr. Stephens: two and one-half years old; with a history that early in November 1922, patient began to have pain, swelling, and tenderness over left knee. This was aspirated by a private physician and pus obtained. Examination for tuberculosis was negative. Examination when first seen by Dr. Stephens on November 14, was as follows; left knee was greatly swollen, red and sensitive; no fluctuation; temperature 101; otherwise general physical examination was negative. Knee was aspirated and bloody fluid obtained. No growth was made. On November 16, patient was admitted to hospital and operation performed; two lateral incisions being made about the knee and two to three ounces of turbid, brownish fluid with many particles of yellowish green fibrin expressed. Sterile dressing applied. No fixation of knee. Laboratory report was staphylococcus aureus. On December 12, traction was applied with knee slightly flexed, and on December 19, complete extension had been obtained and the wounds were clean and granulating. At this time plaster of Paris was applied with leg in full extension. On December 26, it was noted that the patient had slight discoloration of the skin with temperature of 99 degrees, and the eruption was diagnosed 'chicken pox." On February 22, patient was discharged wearing plaster of Paris, holding leg in full extension. Pathologic report from tissue removed at time of operation was made by Dr. Jeffries: "Fibrous and areolar tissue with extensive inflammation. Some areas presented granulation tissue. It does not suggest tuberculosis but this cannot be ruled out."

Dr. William Sneed—Osteomyelitis of the Os Calcis.

Case presented by Dr. Sneed as follows: Case No. 1. Woman 56 years old; considerably emaciated. History of infected foot, 12 years duration; last few months very much worse. Roentgenogram shows diffuse osteomyelitis of the os calcis. Conservative operation: complete heel flap was thrown down from under surface, the whole under surface of the os calcis exposed. Dead bone was not entirely removed. Sub-astragalar joint was opened. With thorough drainage the condition did not improve. Deemed it wise to give transfusion and amputate leg. This was done and healing is taking place by first intention. Case No. 2. White male; operated on December 1, 1923. Diffuse osteomyelitis of the under surface of the os calcis. Considerable of the bone was viable and bled when exposed. The slight shell of bone to which the Achilles tendon was attached was still alive. This part of the os calcis was left. Through-and through drainage was established from the outer to the inner side of the heel. The wound on the inner side was allowed to close, but the outer side was kept open. Another operation was performed in March consisting of removal of some of the superficial tissue so as to prevent healing of the skin edges and a damming back of pus. The wound was packed from the bottom and is now almost entirely healed.

DR. ISADORE ZADEK—Dyschondroplasia.

Patient was first seen in August, 1923, on account of bony prominence about the right elbow, which had existed for about seven years. The patient stated that she had some sort of trivial injury about this time but it was not incapacitating and she paid but little attention to it. The prominence at the elbow had become more marked and the elbow was not functioning as well as that of the opposite side.

August 22, 1923: there is gross deformity of the right elbow, and the forearm is held pronated. There is bony prominence in the position of the head of the radius, which rotates with the shaft. This projects in the line of the radius for 1½ inches. Extension at the elbow is limited to 160 degrees, apparently due to bony prominence of the projecting radius. Supination is scarcely permitted to the neutral position. Pronation is free. Flexion is free. There is ulnar deviation of the hand, which is due to lack of bony support at the wrist. Grip is fair. Flexion at the elbow is weak and there is bony prominence about 2½ inches above the elbow over an area 2 inches long which is not sensitive. The roentgenogram shows a dislocation of the head of the radius with an osteochondroma near the lower end of the ulna and absence of lower end of ulna. Excision of head of radius with its transplantation to the lower end of the ulna and removal of osteochondroma advised.

August 23, 1923. The head of the radius was removed with a projecting part of the neck and shaft, in all about 1¼ inches. Structures closed with catgut. Then an incision was made over the lower end of the right ulna and the osteochondroma removed. The bone was smoothed by means of a file. The gap between the lower end of the ulna and the pisiform bone was found filled with heavy fibrous tissue. This was split. The pisiform bone was explored, then the lower end of the ulna was split with a motor saw and the remodeled head of the radius was fitted into this. No sutures were placed through the bone and it seemed to hold moderately well. The lower end of the ulna was cartilaginous. Plaster cast was applied extending from the base of the fingers to the upper arm with the forearm supinated and the wrist in slight radial deviation and the elbow at an angle of 170 degrees. Following operation temperature rose to 100. Plaster is comfortable and in good condition. August 27, 1923: Fingers are moderately swollen. Is able to flex and extend them and the roentgenogram shows that the remodeled head of the radius is in excellent position. September 19, 1923: Plaster is removed. Both wounds are completely healed. There is some movement permitted where the upper end of the radius has been transplanted to the lower end of the ulna. Union is not solid. Plaster cast applied extending from the base of the fingers to the elbow. Patient measured for a leather wristlet. January 31, 1924: The deformity at the elbow is considerably diminished. The range of extension is not quite complete and the patient has power of supination. The grafted head of the radius is apparently united through its attachment to the small epiphysis at the lower end of the ulna. In view of the radiographic appearance the patient's history is probably correct and the condition is one of dyschondroplasia, described by Ehrenfried of Boston, the explanation of the dislocation being quite simple. The growth of the ulna has been considerably retarded, due to the mal-developed epiphysis, and probably influenced by the cartilaginous exostosis at its lower end. The radius has continued to grow, and being relatively longer than the ulna, it has become dislocated. The condition is of special interest in that the transplanted upper portion of the radius is apparently uniting solidly with the lower end of the ulna as determined by clinical examination and by the radiographic appearance.

Dr. Irving Balensweig—Fracture and Dislocation of the Cervical Spine Without Symptoms.

Dr. Balensweig presented the case of Mr. P. D., age 46, American, elevated railroad motorman by occupation, perfectly well until November 1st, when he lost his footing at the head of a flight of stairs and fell forward, landing at the bottom of twelve steps with his head acutely flexed against the wall. He was unconscious for a period of about twenty minutes according to his sons who removed him to bed from the location of injury. He suffered intense pain for a period of some twenty-four hours and was kept in bed for a period of two weeks, no orthopaedic treatment being instituted. At the end of this time roentgenograms were taken. Patient, however, has been free from pain and symptoms since the third day. Came to the hospital for an opinion, as the medical examiner for the railroad refused to have him return to work. Clinical examination was negative, in so far as there was no restriction of motion in any direction, no pain, and no points of tenderness. There was no weakness of the upper or lower extremities and no sensory changes. Roentgenograms taken in the antero-posterior and lateral planes revealed the following: In the former there was no bone pathology evident; in the latter there was an anterior dislocation of the second cervical on the third, with displacement of about three-sixteenths of an inch. There was also a small fracture of the proximal vertebra. There was also the appearance of a fracture at the base of the odontoid process, with but slight displacement. Patient was measured for a leather collar at the time of admission to the clinic and has been wearing this as a preventive measure.

Dr. Bradley Coley—Flap Graft for Amputation Stump of Toe.

The case presented was a healthy male adult of fifty-four years, who, on September 11, 1923, was run over by a trolley car, the wheel passing over his foot and resulting in a traumatic amputation of the great toe. The line of fracture passed through the base of the proximal phalanx, leaving a few fragments of the phalanx and exposing the head of the first metatarsal. There was a simple fracture of the middle phalanx of the second toe. The skin flap was irregular, jagged, insufficient to cover the exposed head of the metatarsal, and into its substance were ground fragments of the broken phalanx. With the exception of a scalp lesion, the patient sustained no other injuries. Operative procedure: After a thorough preparation of the patient with green soap, alcohol, ether, and iodine, an immediate débridement was done and all small fragments of bone were removed, the skin edges trimmed off and loosely sutured over the head of the first metatarsal, not completely covering the bone. The wound before suturing was flushed out with several quarts of Dakin's solution, and a wet Dakin's dressing was applied. The foot was then encased in a gauze leg-roll and elevated. Subsequent dressings with Dakin's solution were applied for about five weeks, at the end of which time the skin flap had entirely sloughed away and healthy red granulations had covered the entire exposed head of the first metatarsal, leaving a base upon which subsequent flap operation was performed. Second operation, October 23, 1923: A curved flap of the full thickness of the skin of the right calf with its convexity toward the anterior aspect of the calf was elevated and sutured to the granulating surface of the stump of the left great toe. Horse-hair sutures were used to maintain coaptation, and a plaster cast encased both lower extremities, extending to the point of mobilization. Immediately after the operation, a window was cut in the gauze to expose the graft for the purpose of dressing. On about the tenth day, the base of the flap was divided, a third of the base being

divided on each of the three succeeding days. The portion which was sutured to the great toe appeared very dusky, and it was feared that it was not viable. Following the complete division of the base, however, under external dry heat and dressings, the flap recovered, and covered four-fifths of the denuded area. The remainder of the granulating surface about the graft rapidly closed in from both sides and was entirely healed on December 15. The area on the calf of the right leg, from the region of the head of the first metatarsal, is covered with healthy pink epithelium. There is no ulceration or discharge. The patient can walk well without a cane.

Dr. Arthur Krida—A Surgical Approach for Step Operations on the Femur.

Dr. Krida reported a case in which the step operation for lengthening the femur was undertaken. Substantial lengthening was not secured primarily because of an accident during the operation in which the proximal portion of the step was fractured, thus converting the operation step into a fracture with loss of substance in which the fragment had to be utilized as precarious bone graft. The patient was an undersized boy of 10 years. He had poliomyelitis seven years previously. One year previously an astragalectomy had been done for calcaneo-valgus, with a satisfactory result. There was one and three quarters inches of shortening, and since the hip and thigh muscles were of good quality, it was proposed to remedy the pronounced limp and asymmetry. The surgical approach described by Dr. Krida was used and found to be entirely satisfactory. During the first three weeks following operation a lengthening of rather over one inch was obtained by traction, but this lengthening had to be largely sacrificed by considerations of securing bony union. At the end of eight weeks there was radiographic evidence of callus, with good alignment and only slight lengthening.

Dr. Samuel Kleinberg—Traumatic Hypertrophy of Ligamenta Alaria.

This case was presented to call attention again to the diagnostic value of pneumarthrosis. The boy was admitted to the hospital December 29, 1923, because of pain in the right knee and difficulty in walking. His trouble started about four weeks previously when he slipped and wrenched the right knee, which became immediately swollen and painful, but symptoms rapidly subsided. He was able to return to school after several days. About a week later the knee suddenly gave way and became locked and painful. From that time until the present he had fourteen attacks of locking of the knee joint. Examination of the knee showed slight enlargement but no redness or local fever. There was marked tenderness in the region of the internal semilunar cartilage. Roentgenographic examination was entirely negative. The knee was injected with oxygen and another roentgenogram taken, which showed a very marked pathologic thickening of the ligamenta alaria. This pathologic change was not evident in the ordinary roentgenograms and could not have been diagnosed except by pneumarthrosis. At operation the internal semilunar cartilage was found detached and was removed. The ligamenta alaria was found greatly enlarged and congested and was excised.

Case 2—Hypertrophic Synovitis of the Knee treated by Scarification of the Synovial Membrane. This patient was presented to show the therapeutic effect of scarifying the synovial membrane of the quadriceps bursa in chronic non-specific synovitis of the knee. This man sustained an injury to his right knee two years ago and since then has had effusion in the knee with resultant disability. Roentgenogram taken after the knee was injected with oxygen showed a markedly thickened synovial membrane. It was

therefore decided to scarify the synovial membrane with the needle used for aspiration of the fluid. Both the anterior and posterior surfaces of the quadriceps synovial bursa were scarified. A plaster of Paris bandage was applied from the groin to the toes. Roentgenograms taken sometime after this operation showed that there were adhesions between the anterior and posterior surfaces of the quadriceps bursa. Clinically this man is well inasmuch as there has been no recurrence of the effusion.

Case 3—A Case of Spondylitis Deformans. This man was presented to show the value of complete rest in reducing the deformity and relieving the discomfort in an advanced case of spondylitis deformans.

H. C.; male; 39 years old; well up to four years ago, when he awoke one morning suffering from pain in his back. He has had pain and stiffness in the back ever since, and increasing deformity of the spine. On admission he showed a marked degree of rigid posterior curvature of the spine, secondary to spondylitis deformans. His body was bent forward so much that when he was lying on his back on a table his head was 8 inches from the table. His treatment in the hospital consisted of complete rest in bed. At first he had to have several pillows under his head, but gradually the spasm of his muscles relaxed and finally he was able to lie in bed without the use of any support for his head. He was given daily treatments of baking and massage to his back. His tonsils were found enormously enlarged and diseased, and were removed.

The deformity diminished and his pain disappeared almost entirely. Finally he was able to walk around very comfortably, wearing a spinal support, and he was discharged from the hospital with his spine very much straightened.

PAUL C. COLONNA, *Secretary.*

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED NEW YORK, FEBRUARY 27, 1924.

THE PRESIDENT, DR. KRIDA, IN THE CHAIR.

DR. ROYAL WHITMAN—Case Illustrating the Treatment of Extreme Deformity Following Fracture of Spine.

Dr. Royal Whitman presented a boy, 17 years of age, to illustrate treatment of extreme deformity. About three years ago he was injured by a fall, resulting in paralysis of the lower extremities. He remained in a hospital for several months without benefit and was removed in a state of extreme disability by his mother. Since then he has recovered some power of the limbs and partial control of the bladder. On admission he presented extreme spastic contractions of the lower extremities; dislocation of the right hip, and numerous scars of bed sores and others still active. The problem had been to extend the limb and then to enable the patient to stand. At first, an attempt was made under anesthetic to correct the deformity in part, and to apply a double

spica, but this caused retention of the urine and the plaster was removed. The present operation has been transplantation of the biceps on the left side. This has decreased the most resistant part of the contracture at the knee. The same operation will be performed on the other side and then a reconstruction of the hip joint and finally resection of the obturator nerve.

DR. PERCY W. ROBERTS—Bilateral Fracture of Hip.

Dr. Roberts presented a case of bilateral fracture of the hip. The patient was 46 years of age. Nineteen years ago patient slipped with legs in extreme abduction. He walked about for several days before seeking medical advice, and the doctor whom he consulted prescribed liniments. One month after the injury he was admitted to the Post Graduate Hospital and treated for synovitis of the right hip. Traction for several weeks gave no relief. The hip was then explored and it was found that he had sustained a fracture of the neck of the femur. This was nailed but did not unite. He now has 2½ inches shortening on the right side, with free motion and no pain. One year ago he began to have pain in the opposite hip, which has increased until he is now completely disabled. Exploration of the joint showed what appeared to be an old united fracture of the neck of the femur, with the formation of considerable new bone. Roentgenogram showed a mass of bone extending from the level of the great trochanter across to the head, and a protrusion of the acetabulum suggesting an old central fracture. The excess bone was removed until normal range of motion was obtained. Three weeks after operation, at the time of demonstration, patient had flexion to a right angle, some abduction and some rotation, with very little pain. In spite of the favorable condition at present the prognosis is not good as to motion, but reasonably good as to elimination of pain.

DR. ARMITAGE WHITMAN—Cases Illustrating Operative Intervention in Long Standing Disabilities of the Knee.

Dr. Armitage Whitman showed three cases of injury to the knee joint, all of five years duration. Case 1 was typical in history and examination of dislocation of the internal semilunar fibrocartilage. Roentgenogram after oxygen injection was negative. At operation the cartilage was found to be detached and was removed. The patient left the hospital on the fourteenth day and has since been well. Case 2 gave a history very suggestive of a loose body the size of a lima bean lying just below the patella. Roentgenogram after oxygen injection showed the body more clearly and in addition a second smaller one lying just above the spine of the tibia. Both bodies were removed. The patient left the hospital on the fourteenth day. When seen at the conference one month later he volunteered the information that whereas he had been receiving total disability allowance he was the following week to be cut off from all compensation. Case 3 was typical of a dislocated cartilage with recurrent attacks of synovitis and consequent relaxation of the capsule and lateral mobility of the joint. 100 cc. of fluid was aspirated. Oxygen injection performed. The roentgenogram was negative. The fluid recurred in the same volume in twenty-four hours. Operation disclosed a loose cartilage, which was removed. In addition the synovial membrane was greatly thickened and of a dirty gray color. This was swabbed with full strength iodine and the joint closed. The patient began motion in bed on the tenth day, was discharged on the twentieth day with 45 degrees flexion at the knee, and no fluid in the joint. When last

seen at the Veteran's Bureau, March fifteenth, there was 90 degrees flexion, less lateral mobility, and no fluid in the joint. There had been no recurrence of the locking. Dr. Whitman showed the three cases to illustrate various points. The first was the long standing disability of the patients, and the fact that they had all been told by every one of the numerous surgeons that they had seen that not only was it doubtful whether or not they actually had anything the matter with them, but if they had they must accept disability with resignation, as surgical intervention would inevitably result in stiffness. Case 1 was a simple routine case. Case 2 illustrated the occasionally great value of oxygen injection, as without it the smaller of two loose bodies might very easily have been overlooked. Case 3 also showed the usefulness of oxygen injection, but what Dr. Whitman thought was more interesting and important, the occasional success of conservatism. It had been suggested by a bystander at the operation that the case was suitable for synovectomy, and, indeed, he himself had felt that such a procedure might eventually be necessary. Whereas after simple aspiration the fluid had immediately recurred, following operation and the swabbing with iodine it had never been demonstrably present. The residual stiffness he felt was an advantage in providing opportunity for shrinkage of the relaxed capsule, and he felt sure that this would eventually disappear. In conclusion he felt that while it was the general impression that surgery applied to the knee joint was a last and desperate resort, actually, coupled with exact diagnosis and careful technique, the joint offered one of the most brilliant fields of surgical opportunity.

*Dr. Lewis Wagner—A Large Intra-articular Tumor of Knee Joint. Report of a Case of Fibro-endothelioma Arising from Synovial Tissue.

A man, 35 years old, musician, with a negative family and past history, began without any apparent cause, 3½ years ago to complain of pain in right knee. He was given the usual rheumatic treatment by the family physician but with no improvement. In the summer of 1923, he consulted a surgeon, and the limb was immobilized in plaster, without any relief of symptoms. He came under the care of Dr. Gibney and Dr. Wagner in October, 1923. Examination showed the patient in good condition, walking with a slight limp, although the functions of the right knee were not impaired. There was one inch difference in the measurement of the knees, with a slight fullness under the right patellar tendon, which was slightly tender. He brought a negative report of radiographic findings, although I did not see the pictures. The case was thought to be one of chronic synovitis, especially of the retropatellar sac, and was treated conservatively with cautery and strapping. He did not improve, but rather the pain became worse and extremely so in wet weather, so that it required codein for relief of pain. In January, 1923, a roentgenogram was taken, which showed a mass behind the patellar tendon, thought to be hypertrophied synovial tissue, but a definite tumor was not considered. On looking back, it can be easily diagnosed. On February 13, 1924, the patella was split and the knee joint exposed. A solid tumor covered by a synovial veil lay in the knee joint. It was attached to the outer antero-inferior border of the capsule by a small attachment. The tumor was so large that it was divided longitudinally to facilitate removal and shelled out with little difficulty. The knee joint was perfectly normal otherwise.

* This case was substituted for the one which appeared in the program.

DR. IRVING BALENSWEIG—Dislocation of Carpal Semilunar.

Dr. Balensweig presented the case of Mr. M. M., age 48, Russian, white, garage owner by occupation, who was perfectly well until January 28, when, as he was opening the rolling door of the garage he was struck from behind by a taxi cab on its way out, thus causing acute hyperextension of the left hand. He suffered intense pain in the wrist and was removed immediately to St. John's Hospital in Brooklyn, where within a period of two hours an attempt was made under an anesthetic at reduction of the dislocation. This, however, was unsuccessful, and during the next two days other unsucful attempts were made, on these occasions no anesthetic being used. He was first seen on February 2nd, the roentgenogram disclosing an anterior dislocation of the carpal semilunar bone of the left wrist, a fracture of the tip of the styloid process of the radius, and a slight rotation and forward dislocation of the scaphoid bone. Because of the persistent pain it was advised that the semilunar bone be removed. This was done on February 4, after an unsuccessful attempt at closed reduction. Since operation, the patient has been receiving physiotherapy. Recovery is but slight. Condition is complicated by the presence of anesthesia along the course of the median nerve of the hand.

Case 2. Mr. L. L., age 18; fell on the outstretched left hand while running, sustaining an injury to the hand for which two plaster splints were applied at a hospital a month prior to coming to this clinic. Came to clinic in November, 1922, because of persistent pain and swelling of the fingers. Examination showed swelling of the wrist and fingers with restriction of motion of wrist in all directions; no sensory changes. Roentgenogram showed a fracture of the scaphoid bone and dislocation of the carpal semilunar bone. This was not recognized prior to taking of the roentgenogram. Operation advised. Patient was operated upon a week later by Dr. Whitbeck, who removed the scaphoid and was able to reduce the dislocation of the semilunar bone at the time of operation. After discharge from hospital patient received physiotherapy until six months ago. Examination at the present time shows patient with restricted motion of extension, and with flexion of the wrist about half the normal range. There is also a definite radial abduction deformity of the wrist. Movement, however, is painless and function is good. These two cases were shown because of the rarity of the condition.

DR. SAMUEL KLEINBERG—Case Illustrating Treatment of Second Stage of Anterior Poliomyelitis in Hospital Ward.

This case of infantile paralysis was presented to call attention to the advantage of applying in a hospital the extensive, complicated, and time-consuming but ideal treatment necessary to obtain the maximum improvement prior to the stationary period. Except during epidemics we are not inclined to fill our wards with cases of poliomyelitis in the improvement stage because (1) the treatment can be carried out fairly well at home; (2) the improvement is usually so slow as to discourage interest of the Medical Staff occupied with an active operative service; (3) the treatment necessarily prolonged takes up a lot of time of the nursing staff, and (4) the hospital expense is considerable. In the majority of the cases the treatment can be administered satisfactorily at home, but in those instances in which, as in this patient, the paralysis is very extensive, hospital care is not only desirable but is indispensable, if we are to prevent deformities and obtain the best possible result. The physician can not only study the condition carefully and prescribe accordingly, but can on his daily rounds be sure that the treatment is being

given properly and observe the progress. Helen S. was paralyzed in August, 1923. On admission she had practically complete paralysis of all the extremities and marked weakness of the abdominal and back muscles. She was helpless and bed-ridden. The upper limbs were supported with the arms abducted. Splints were applied to the legs to prevent drop-foot. She has worn flannel pajamas and woollen stockings to prevent cooling of the affected muscles. A board under the pelvis has kept the hips in complete extension. She has been getting a daily, warm, three percent. salt solution bath, with the proper measure of massage and exercises of the limbs in the bath. She has also been receiving daily treatments of regulated exercises of the active muscles; these are preceded by a short period of stimulation and warmth of the muscles by exposure to radiant heat. The limbs are supported by means of canvas bands suspended from a Balkan frame and are exercised at regular intervals by voluntary use of the active muscles. All of the treatments have been arranged so that the patient, while getting much attention, still has sufficient rest during the day. As a result of the intensive care not only have deformities been prevented but a marked improvement has been obtained. She has regained some power in all her limbs. She can sit up unsupported and can even stand a little.

PAUL C. COLONNA, *Secretary.*

REPORT OF THE MEETING OF THE CONFERENCE BOARD OF PHYSICIANS IN INDUSTRY.

The Conference Board of Physicians in Industry was organized in April, 1914 for the object of furthering co-operative methods in introducing into industrial establishments the most effective methods for the treatment of injuries, for caring for the ailments of employees, for the promotion of improved sanitary conditions in industry, and to aid in the prevention of industrial diseases. Since its organization, this Conference Board has held forty-one meetings, in which the important medical problems have been presented and discussed by the different members.

On April 4th and 5th, 1924, the Conference Board met to celebrate the tenth anniversary of its organization, and this meeting was attended by over a hundred physicians and by many executives connected with various large industries in all sections of the country east of the Mississippi river. This conference was marked by the unusual feature of speakers from both the medical and executive departments from the large and important industries who discussed together the problems which have so common an interest. The Conference illustrated an important step which has taken place,—namely, the recognition of the mutual interest and responsibility of the medical and the administrative departments of these large industries, and also the necessity of establishing a coöperation between the two, that the best results may be obtained in the most efficient way and in the shortest time. In this way, the medical representatives were able to present the problems which contantsly confront them in the administration of

their duties, and the executives were able to present to the medical profession the difficulties which are sometimes encountered in carrying out the requests of the medical department. Since the spirit of the meeting was such as to invite open and constructive criticism, the benefit derived was mutual. A meeting of this character denotes a marked step in advance, demonstrating as it does the growing coöperation between the departments which in the past have sometimes worked not too harmoniously.

The meeting was held in the Hotel Astor, beginning with a luncheon during which the different visitors were able to become acquainted, and followed by papers during the afternoon and evening. The following list of papers and addresses had been arranged:

2 to 5 p.m.—Afternoon Session.

Presiding: Dr. J. J. Moorhead, Chairman, Conference Board of Physicians in Industry.

American Public Health Association and Industrial Medicine.

Dr. W. H. Park, President, American Public Health Association, New York.

American Medical Association and Industrial Medicine.

Dr. Edward Livingstone Hunt, Assistant Professor of Clinical Neurology, Columbia University, New York.

Function of the Physician in Industry.

Dr. L. A. Shoudy, Chief Surgeon, Bethlehem Steel Co., Bethlehem, Pa.

Employers' Cooperation in Medical Work.

Mr. C. R. Hook, Vice-President, American Rolling Mill Company, Middletown, Ohio.

Employers' Interest in Industrial Medicine.

Mr. Samuel Gompers, President, American Federation of Labor, Washington, D. C.

Inspection in Physical Diagnosis.

Dr. Harlow Brooks, Professor of Clinical Medicine, New York University and Bellevue Hospital Medical College, New York.

Monopolistic State Insurance and Industry.

Dr. O. P. Geier, Manager, Employee's Service Department, Cincinnati Milling Machine Co., Cincinnati, Ohio.

7 p.m.—Dinner and Evening Session.

Presiding: Dr. W. Irving Clark, Vice-Chariman, Conference Board of Physicians in Industry; Service Manager, Norton Co., Worcester, Mass.

U. S. Public Health Service and Industrial Medicine.

Dr. H. S. Cummings, Surgeon-General, U. S. Public Health Service, Washington, D. C.

The Conference Board of Physicians in Industry.

Mr. Magnus W. Alexander, Managing Director, National Industrial Conference Board, New York.

Traumatic Surgery—Its Development and Relation to Industry.

Dr. J. J. Moorhead, Professor of Surgery, New York Post Graduate Medical School and Hospital, New York.

What Industry Requires of Medical Supervision.

Mr. Howell Cheney, of Cheney Brothers, South Manchester, Connecticut.

Industrial Medicine and Medical Education.

Dr. W. Gilman Thompson, President, Reconstruction Hospital, New York.

In addition to the papers presented by the members of the Association, there were addresses given by Dr. R. C. Williams, who spoke for Surgeon-General Cummings of the United States Public Health Service on the U. S. Public Health Service and Industrial Medicine, and explained the work which has been carried on by the government in promoting measures for improving the health conditions in industry. Mr. Samuel Gompers, President of the American Federation of Labor, discussed the employee's interest in industrial medicine and the effort which had been made by the Federation of Labor toward the bettering of the employee's working condition. Mr. C. R. Hook, Vice-President of the American Rolling Mill Company, told of the value of the physician's work from the employer's point of view, and spoke of the very great benefit which the industry had derived from the active efforts of the medical profession. Mr. M. W. Alexander, Managing Director of the National Industrial Conference Board, reviewed the work of the Conference Board in its administration and its influence on industrial conditions. He reviewed in a very clear manner the change in the situation of the workman and his relation to his employer from the time when industry was confined to small groups and when the personal interest of the employer and the employee was an intimate one, and then followed the development of industry on the larger scale with the diminishing personal contact between the employer and employee which accompanied the gradual extension of labor, and then described in an interesting manner the present increasing development of the interest of the employer in the employee. Mr. Howell Cheney, of Cheney Brothers, South Manchester, Connecticut, described what industries require of medical supervision and gave very practical advice on the necessary work of the physician in industry and helpful suggestions as to methods of administration and coöperation with the executives. Dr. W. H. Park, President of the American Public Health Association, and Dr. E. Livingstone Hunt, Secretary of the New York Medical Society, spoke of the relations of their respective societies to the work of these physicians, and Dr. W. Gilman Thompson described the object of the work of the Reconstruction Hospital of New York.

The sentiment in practically all the discussions emphasized the fact that medical work in industry was a necessity and demanded by the existing social order; that only practitioners with high ideals of service and an adequate grasp of the problems to be solved could hope to be successful in this work; that it must be conducted on a high ethical plane and with strict regard to the scientific consideration of the work; and that when properly conducted, it was a potent factor in advancing the cause of preventive medicine both in personal and community health.

It was felt that medical work in industry did not antagonize or supplant the work of the private practitioner except in those cases where the services offered by private practitioners were not adequate to meet the needs of industry. On the other hand, the work of the capable private practitioner had been increased by the work of the physician in industry, who by educational methods has aroused in the minds of the workers added interest in health subjects. By this means, a spirit of cooperation is engendered which is beneficial to all parties concerned.

On Saturday, April 5th, the physicians attending this meeting were guests of the Post Graduate School of Medicine of New York, and a series of clinics were opened to meet their needs and to demonstrate work which would be of value to them.

During this session, Dr. Moorhead held an interesting operative clinic of hernias, and demonstrated several forms of knee-joint injuries with their treatments and results, and also of fractures and back injuries. Professor Buchanan explained different

methods of anaesthesia, which could be used particularly in the reduction of fractures, dislocations, and other minor surgical operations requiring short anaesthesia. He also compared the value of different forms of anaesthetics, particularly describing the methods of administration of ethyl chloride, with its advantages and disadvantages. Professor W. H. Meyer demonstrated a large collection of roentgenograms of bone tumors, fractures, and dislocations, and also showed roentgenograms which demonstrated foreign bodies in the lungs and explained the methods of taking these pictures, and the essential elements of diagnosis. Professor Halsey discussed the diagnostic methods in pulmonary and cardiac lesions and the advisability of employing cardiac and pulmonary defectives in industry. Professor Ward McNeal discussed laboratory aids in diagnosis, with a consideration of the significance of certain tests.

News Notes.

Meetings of the Section in Orthopaedic Surgery of the New York Academy of Medicine were held on March 21st, April 18th, and May 23rd.

The programme of the March meeting was as follows:

PRESENTATION OF PATIENTS AND REPORTS OF CASES. (From Fordham Hospital.)

(*a*) Bone Graft Cases.
Sarcoma of the femur. Alexander Nicoll (*by invitation*).

(*b*) Sarcoma of Fibula, with lantern slides.
Fracture of Femur. Anthony Hart Harrigan (*by invitation*).

(*c*) Obstetric Brachial Paralysis (showing results of operation 2 cases) with lantern slides.
Pneumoarthrosis.
Fractures in the Region of the Elbow Joint (3 interesting cases).
Congenital Cystic Degeneration of Ulna and Humerus, with lantern slides. S. W. Boorstein.

(*d*) Chronic Osteomyelitis treated by Artificial Heliotherapy. Cases and lantern slides. A. Nicoll, E. R. Cunniffee and S. W. Boorstein.

(*e*) Interesting fracture cases. E. R. Cunniffee (*by invitation*).

(*f*) Ununited fracture of Humerus, operation, delayed union. R. Emmet Walsh (*by invitation*).

(*g*) Radiographs from interesting Bone Cases. Isidor J. Landsman and Henry P. Hirsch (*by invitation*).

PAPER OF THE EVENING:

"Certain types of painful shoulder." Illustrated with lantern slides. James Morley Hitzrot (*by invitation*).

SYNOPSIS:

Inflammation of the bursae about the shoulder; sub-bursal conditions; fractures of the greater tuberosity.

DISCUSSION.

At the April meeting the programme was as follows:

PRESENTATION OF PATIENTS AND REPORTS OF CASES. (From Mt. Sinai Hospital.)

(*a*) Aseptic bone necrosis in joints, and its relation to osteochondritis dissecans; demonstration of cases; lantern slides. Edgar D. Oppenheimer.

(*b*) Bone abscess in close proximity to a large coronoid foramen.

(*c*) Bony ankylosis of the hip from osteomyelitis in infancy; fracture of the neck of the femur.

(*d*) Bony ankylosis of the knee following osteomyelitis; fracture of the tibia. Sigmund Epstein.

(*e*) Demonstration: Coxo-femoral osteomyelitis in adults. Lantern slides. P. William Nathan.

PAPER OF THE EVENING:

"End-result of operative reconstruction work on the upper extremity." Arthur Steindler, Iowa City, Iowa (*by invitation*).

SYNOPSIS: Flail shoulder; flail hand; pronation contractures; thenar palsies; dermatogenous contractures; arthroplasties of the elbow; peripheral nerve injuries; the after treatment and functional records. Lantern slides.

DISCUSSION.

At the May meeting the programme was as follows:

PRESENTATION OF PATIENTS AND REPORTS OF CASES. (From Lenox Hill Hospital.)

(*a*) A subcutaneous method of lengthening the tendo Achillis.

(*b*) Treatment of periarthritis of the shoulder by injection of quinine and urea hydrochloride. Walter I. Galland (*by invitation*).

(*c*) Case of untreated congenital dislocation of the hip in an adult. Harry D. Sonnenschein (*by invitation*).

(*d*) Case of Pott's fracture complicated by fracture of posterior portion of articular surface of tibia. John C. A. Gerster.

(*e*) Result of operation for ulnar palsy.

(*f*) Subcutaneous suture for fractured patella. Jacob Heckmann (*by invitation*).

(*g*) Case of ulnar palsy fifteen years following injury; operation, cure. Charles H. Jaeger.

PAPER OF THE EVENING:

"A brief survey of the teaching of orthopedic surgery in medical schools." Robert B. Osgood, Boston, Mass. (*by invitation*).

DISCUSSION.

The annual Meeting of the British Orthopaedic Association took place in London, May 16th and 17th, 1924, with Sir Robert Jones presiding.

The programme was as follows:

FRIDAY, MAY 16, 1924.

MORNING SESSION

(At the ROYAL SOCIETY OF MEDICINE, 1, Wimpole Street, W.1.)

9.30 a.m. Annual General Meeting—Executive Session.

10.00 a.m. Discussion on "Internal Derangement for the Knee Joint." Opened by Mr. W. ROWLEY BRISTOW.

1.00 p.m. Luncheon at the Langham Hotel for Members desiring it.

AFTERNOON SESSION.

(At the HOSPITAL FOR CHILDREN, Great Ormond Street.)

2.00 p.m. Clinical Meeting—

Operations and Cases, arranged by Mr. FAIRBANK.

7.30 p.m. ASSOCIATION DINNER.

(At the Langham Hotel).

SATURDAY, MAY 17.

MORNING SESSION.
(At the ROYAL SOCIETY OF MEDICINE,
1, Wimpole Street, W. 1.).

10.00 a.m. Short Papers:—

1. "The Etiology of Pseudocoxalgia: Some Clinical Points Opposed to the Flattened Socket Theory." Mr. G. PERKINS.
2. "The Operative Treatment of Knee Flexion in Poliomyelitis." Mr. S. ALWYN SMITH.
3. "Traumatic Paralysis in the Mother produced during Labour." Mr. C. LAMBRINUDI.
4. "Caries of the Lamina of a Vertebra." Mr. J. B. BARNETT.
5. "Clinical Notes on (a) Polyarthritis (Still's Disease); (b) Tuberculous Osteomyelitis." Mr. J. G. JOHNSTONE.

AFTERNOON SESSION.
(At ST. VINCENT'S HOSPITAL, Pinner).

2.30 p.m. Clinical Demonstration. MR. AITKEN.

The following notice of a competition under the auspices of the Istituto Ortopedico Rizzoli of Bologna has been received.

The competition for the prize UMBERTO I. has been opened.

This prize of 3.500 lire will be assigned, according to the decision of the Provincial Council of Bologna, for "the best orthopaedic work or invention."

Italian and foreign doctors may take part in this competition.

The arrangement of the competition and the assignation of the prize is fixed by the regulations which will be sent to whomever asks for them.

Application for the competition should be made to the President of the Rizzoli Institute in Bologna.

The competition will close December 31, 1924.

Bologna, January 1, 1924.

G. PINI, *President.*

Notice has been received of the recent death of Prof. S. G. Shattock, an Honorary member of the British Orthopaedic Association.

BOOK REVIEW

INTERNAL DERANGEMENTS OF THE KNEE-JOINT. THEIR PATHOLOGY AND TREATMENT BY MODERN METHODS. A. G. Timbrell Fisher, M.C., F.R.C.S. (Eng.) The Macmillan Company, New York, 1924.

One of the most interesting books that we have read for a long time is this little monograph of 144 pages on internal derangements of the knee. All lesions capable of causing mechanical interference with function of the knee are considered, including affections of the semilunar cartilages, loose bodies in the joint, chronic non-tuberculous arthritis, sprain of the lateral ligaments, rupture of the crucial ligaments, injuries of the tibial spine, hypertrophy of the infra patellar pad of fat, exostoses, slipping patella, etc. The length to which these conditions are discussed is directly proportionate to their relative importance. Quite rightly, because of their much greater frequency, nearly two-thirds of the space is devoted to a consideration of the lesions of the semilunar cartilages and to loose bodies.

Mr. Fisher has devoted much of his time since the war to a study of both the normal and pathologic anatomy of joint structures, and has had at his disposal the resources of the college of Surgeons in London, and a grant of funds from the Council for Medical Research. In the course of his investigations he has conducted numerous animal experiments. The knowledge of pathology which he has thus acquired is here made available in its practical relations to clinical conditions, and it is this which constitutes the outstanding feature of the book. The value of manipulative treatment is also considered, and the good results which have undoubtedly been obtained by "bonesetters" in certain cases here find their rational explanation. There is a foreword by Sir Arthur Keith and there are critical foot notes by Sir Robert Jones, the latter in characteristic vein. There are also forty plates, with eighty figures, which are unusually good.

Material will be found here for profitable study by every orthopaedic surgeon and of value to all who engage in the surgical treatment of affections of the knee.

Current Literature

FRACTURES AND DISLOCATIONS

NON-UNION IN SHAFT FRACTURES: THE TREATMENT. Frederic J. Cotton. *Boston Medical and Surgical Journal*, November 29, 1923, p. 845.

The common classes of fractures in which non-union occurs are, roughly speaking, of three types: the displacement cases, (faulty apposition), the delayed unions, (healing process slow), and those in which there is plenty of callus but the fragments do not unite. These fractures involve the lower leg, femur, humerus, and forearm, in this order as to frequency. The causes are: first, something between the bone; second, imperfect setting; third, and most often, imperfect fixation. Add to these, lack of care with regard to circulation, failure to use, massage, etc.

The old treatment of bone pegs, refreshing and wiring, passive congestion, von Schmieden's blood injection, bone plating, etc., were all more or less unsuccessful, and of late the fashion has been bone grafting.

The writer's treatment is as follows. In the displacement cases, ends of fragments are squared or fitted and held with plates. In some also small grafts are used. In the delayed union, nutrition rather than correction is the problem, freshening up the ends, sometimes small grafts. In the non-unions, chip grafts, perferably from inner aspect of shin, dredged into line of fracture. In after care, rest until the beginning of aseptic repair, then massage, baking, and diathermy, and finally exercise through functional use.—*Howard Moore, M.D., Boston.*

FRACTURE OF THE ODONTOID PROCESS AND PARTIAL DISLOCATION OF THE ATLAS WITHOUT COMPRESSION OF THE CORD. G. Nicholson. *British Medical Journal*, March 15, 1924, p. 465.

A laborer aged 50 was struck and knocked down by a falling tree. He did not lose consciousness.

A wound 9 inches long stretched across the frontal eminences from one temporal region to the other. The scalp was hanging loose; the bone was contaminated with mud. The wounds were cleaned and sutured. He complained of pain and stiffness in the neck. The wounds healed without suppuration. Six weeks later a roentgenogram was made.

This showed the anterior arch of the atlas and the odontoid process to be displaced backwards. No line of fracture could be made out, but there was abundance of callus, and union was satisfactory.

Ten weeks after the accident, the patient could get about without any retentive apparatus. The movement of rotation was very limited and was accompanied by pain and a clicking sound.

The article is accompanied by line drawings illustrating the lesion.—*Alexander Gibson, M.B., Ch.B., Winnipeg.*

CONGENITAL DEFECTS AND DEFORMITIES

RADICAL OPERATIVE TREATMENT OF OLD CONGENITAL DISLOCATED HIPS. Deutschländer. *Ztschr. f. orth. Chir.*, 1923, XLIV, 1-2 H., p. 147.

Contrary to the prevailing opinion, the author asserts that these conditions are not incurable but can be restored by careful and reliable operative procedures. The true problem of the radical interference consists in the technical overcoming of the obstacles which oppose the reformation of a joint. These obstacles lie in the altered soft structures. It is not the skeletal changes that are decisive, but the changes in the muscles, joint capsule, and ligaments. Especially important is the psoasiliacus muscle which, in a dislocation, transforms the one armed lever of the femur into an irregular double armed lever, the pivot of which is at the attachment of the trochanter minor. With the femur in abduction and inward rotation, the iliopsoas muscle closes the isthmus of the acetabulum. Herein lies the secret of reduction of the old hip dislocations. Free exposure of the entire field of operation and removal of these obstacles allow reposition of the femoral head.—*A. Gottlieb, M.D., Los Angeles, Calif.*

TREATMENT OF WEBBED FINGERS, CONGENITAL OR ACQUIRED. G. M. Dorrance and J. W. Bransfield. *Annals of Surgery*, Oct., 1923, p. 532.

The object of the operation is to cover the area and prevent the recurrence of the web. The former is accomplished by the use of the Ollier-Thiersch graft; the latter by the Agnew flap. The sloping found in a normal hand starting from a point opposite the middle of the first phalangeal bone is accomplished nicely by the Agnew flap. An Agnew flap is outlined and dissected free to its base. The web is then divided in the mid-line, well beyond where the normal web would be; then by pressure with the gloved finger the separation of the soft tissues should be continued until it has been separated deeper than in the normal hand. The Agnew flap is now sutured in place. An impression of the area between the two fingers produced by the division of the web is then made in modeling compound, and after covering the raw surface with an Ollier-Thiersch graft the modelling compound is re-introduced over the graft. This modelling compound has the advantage of keeping the fingers well separated, and holds the graft in accurate approximation with the raw surface, thus preventing serum from collecting under the graft as well as keeping the grafts at body temperature. It is advisable not to remove the web on the adjacent fingers at one sitting. The whole hand, including the modelling compound, is placed on a splint extending well over the forearm to prevent any extension or flexion of the fingers. The modelling compound is removed in about ten days. In the acquired type of webbed fingers due to burns, an Agnew flap is often impossible to obtain. In this case a central division of the web is made and an impression taken. An Ollier-Thiersch graft is placed over the entire area and then the authors continue as for congenital webbed fingers. They claim good results by this method and they explain their operation well by means of diagrams.—*Voigt Mooney, M.D., Pittsburgh, Pa.*

BIPARTITE PATELLA. J. Fournier. *Revue d'orthopédie*, Sept., 1923.

This article has to do with an anomaly of the patella characterized by its appearance in two segments, one being the main portion and the other, much smaller, situated at the periphery, usually at the supero-external angle. This anomaly is bilateral and

as a rule symmetrical. It is revealed only by the roentgenogram and is to be regarded as a congenital anomaly due to a point of complementary ossification. Thus the original conception of the invariable development of the patella by a single centre needs modification. Its clinical importance is in two distinct classes. 1. In childhood this epiphyseal centre may, like that of the os calcis or of the tuberosity of the tibia, become irritated and inflamed, causing an effusion in the knee joint. Without a knowledge of the presence of such an abnormal epiphyseal centre at the margin of the patella, the origin of the joint effusion would be in doubt. In such a joint condition, rest usually suffices for a cure. 2. In adult life, following an injury to the knee, the radiogram might be wrongly interpreted as showing a vertical fracture of the patella. A radiographic examination of the uninjured knee would, however, reveal exactly the same condition, thus ruling out fracture.—*J. Appleton Nutter, M.D., Montreal.*

Arthrogryposis Multiplex Congenita. Walter G. Stern, *Jour. A.M.A.*, November 3, 1923.

This is a very interesting condition and is well described. The principal characteristic is congenital limitation of motion of all the joints of the body except the maxillary joints and the vertebral column. The thighs are rotated outward and the arms inward. It is a fibrous ankylosis. The patients are subjects for institutional care. —*Edward S. Hatch, M.D., New Orleans, La.*

TUBERCULOSIS

Tuberculous Hydrops of the Sub-Deltoid Bursa. Berard and Dunet. *Rev. de Chir.*, LXI, 1923, p. 194.

The comparative rarity of this condition is given as the reason for reporting the authors' case. The latest study of the subject is said to be that by Avoni (Chirurg. degli Org. di Movimento, April, 1922), who had not been able to collect over thirty cases of subdeltoid bursal hydrops; not all of these were of tuberculous origin. The authors' patient was a woman of 39, presenting a swelling, size of an orange, over the anterior aspect of the left shoulder joint. Slight pain had been noted about twelve months earlier, but diminished with the appearance, six months later, of the gradually increasing swelling. There was no limitation of joint motion. Roentgenographic appearances were normal. At operation the bursal sac was resected, it is said, in its entirety. It contained only a thick, clear fluid; no rice bodies. The walls were from 3 to 4 mm. thick, with a corrugated synovial lining, studded with fibrinous areas. Histologically, all the various elements of tuberculous infiltration, including caseous areas, were found. The case was reported three years after operation, at which time there had been no recurrence, and joint function was normal. Early operation is urged, for although evolution is gradual, and general health little affected, the condition constitutes a constant menace to the underlying joint.—*Roades Fayerweather, M.D., Baltimore, Md.*

POTT'S CARIES SUCCESSFULLY TREATED BY PASSIVE CONGESTION. V. S. Delaney. *Practitioner*, June 1923.

We will all be interested to know that Delaney reports a single case of Pott's disease which in his own words, "I successfully treated in six weeks." Briefly, the young lady injured her spine when 18 years of age and evidently was properly treated with a plaster cast by a Dublin surgeon. Later, an abscess developed with paraplegia and in this condition our reporter found her. Having heard of Bier's treatment he applied cups, absorbed the abscess, and had the patient up and walking in six weeks. He adds, "I was now satisfied that there was osseous union established." He then added Swedish movements twice a day, fifteen minutes at a time. He further adds that "at the end of the three months the patient was able to play me a game of tennis, and I have since seen her dance for a whole night." Pretty good for six weeks' treatment.—*Charles A. Parker, M.D., Chicago.*

TUBERCULOUS TENOSYNOVITIS OF THE HAND. A. G. Kanavel. *Surg., Gyn., and Obst.*, November, 1923, p. 635.

The author reports fourteen cases, thirteen of which were treated by excision of the diseased tissue. The pathology and symptomatology are clearly and concisely given. Especially interesting are his observations that the median nerve is often irritated but practically never invaded by the disease, and that in only one of his cases were the tendons of more than one finger destroyed. His method of procedure is as follows: the brachial plexus is blocked by injecting ½% novocaine above the clavicle. A bloodless field is obtained by maintaining constriction with a blood pressure apparatus. In the case of the flexor tendons a median longitudinal incision is made, the median nerve is identified and dissected free. Then each involved tendon is freed of its thickened visceral sheath by sharp dissection, the tuberculous tissue remaining in one or two masses. The incision is extended as far as necessary to remove all of the diseased tissue. After the tuberculous tissue is removed any fragmented tendons are repaired by suturing them to the adjacent tendon. The wound is closed without drainage, no splint is used, and the patient is told to begin to use the hand as soon as the wound is healed. In cases in which the flexor tendons were involved all were cured, with practically complete function. In four cases in which the extensor tendons were involved, two were cured and two recurred.—*J. Albert Key, M.D., Baltimore.*

A NEW OPERATIVE PROCEDURE IN THE TREATMENT OF SPASTIC PARALYSIS AND ITS EXPERIMENTAL BASIS. N. D. Royle. *The Medical Journal of Australia*. Jan. 26, 1924. p. 76.

In spastic paralysis the muscular rigidity is the greatest factor in the procedure of disabilities and deformities.The author feels that the rigidity must be due to some other factor than that which is usually attributed to medullated nerve fibres. It is known that voluntary muscles receive non medullated fibres from the sympathetic system. The function of these fibres is not known. Experiments were undertaken to determine the function of these fibres and their relation if any to the rigidity of spastic paralysis.

Attempts to produce spastic paralysis in animals as it occurs in the human subject were not successful. Hypertonicity, however, was produced by division of the cord and by decerebration. Most of the experiments were conducted upon goats because

the sympathetic trunks are better defined in larger animals. In brief the results of his experiments are as follows:

1. In a normal animal removal of the left abdominal sympathetic caused a depression of reflex activity in the left lower limb and a disturbance of the mechanism for maintaining the posture of limb, but did not interfere with the animal's ability to control the limb.

2. In an animal with a transverse section of the cord, removal of the left abdominal sympathetic caused the left lower limb to be less spastic and the knee and the ankle jerks to be less active than on the right side.

3. In a decerebrate animal in which the left abdominal sympathetic had been removed some time previously the decerebrate rigidity did not occur in the left lower limb. The limb participated in the periodical extending movements, but fell into flexion immediately in contrast to the other limbs which remained extended.

The results were so striking that it was determined to try the method clinically. Two cases are reported.

1. A man had spastic paralysis, right upper and lower extremity and left leg and foot, following a gun shot wound of the cerebral cortex seven years previously. The right lower limb was very rigid and could not be controlled. He also suffered from constipation. At operation, through an incision lateral to the right sacro spinalis and forward along the iliac crest, the right sympathetic trunk was exposed. The white ramus from the second lumbar nerve was divided, the grey rami to the second, third and fourth lumbar nerves were avulsed, and the sympathetic trunk was sectioned immediately below the fourth lumbar ganglion, thus dividing the grey rami to the fifth lumbar and the sacral nerves. Recovery was uneventful. Fifty-four days after operation the patient relaxed the formerly spastic limb almost normally and the knee and ankle clonus had disappeared, nor was there any sign of abnormal tone or atrophy in the muscles of the right lower limb. The constipation disappeared.

2. Spastic hemiplegia of 14 years' duration. The right upper limb was contracted and useless. At operation the roots of the brachial plexus were exposed; the grey rami to the whole plexus were avulsed. The recovery was uneventful. Two weeks after the operation there was remarkable gain in voluntary control of the formerly useless extremity. (The above article is abstracted in detail because the precedures seem to be sound and of fundamental importance).—*J. A. Key, M.D., Baltimore.*

Bone Cysts. Roederer. *Revue d'Orthopédie.* November, 1923, p. 155.

Cystic appearance in the bone may result from degeneration and softening or from hemorrhage of certain neoplasus, from enchondromas and mixed forms of sarcoma, from bone absorption in phosphorous poisoning, from osteitis of syphilitic or tubercular origin, from actinomycosis, from dystrophic affections, such as osteitis fibrosa and osteomalacia.

There exists, however, a form of bone cyst distinct from these in which the lesion is solitary, and essential or idiopathic in nature. This paper deals only with the definite clinical entity characterized by the formation of a cystic cavity in a long bone near the epiphysis without involvement of the neighboring tissues, without any general pathology which would explain the lesion, and with a benign course without metastasis.

These cysts occur usually in patients between 10 and 30 years of age. Trauma has been noted in the history in about 80% of the cases, but it is probable that the cyst

existed before the trauma and that the injury lead to its discovery. Femur, humerus, and tibia are the most common sites of the lesion. Pain is sometimes present, dull but persistent. Swelling may be noted, but the overlying skin is normal. In exceptional cases fluctuation may be felt. The general condition of the patient is usually perfect and the neighboring joints and muscles are normal. Fracture may occur with very slight injury, and without subsequent pain, ecchymosis, or crepitation. The deformity, however, may be marked.

Left to itself, a bone cyst may disappear spontaneously, or it may increase in size; it may result in a spontaneous fracture or it may remain stationary. After fracture there may be rapid consolidation and the cyst may be filled up by new bone.

Prognosis in general is good. Radical intervention usually gives complete cure.

The question of diagnosis usually comes up in one of two ways: either the occurrence of a spontaneous fracture or the observation of a swelling. Confusion with chondroma is common. The cyst is more rapid in development and does not involve the epiphysis. Central osteo-sarcoma is painful, while a cyst is not. Peripheral sarcoma is more irregular than a cyst and may present masses of soft tissue and have dilated veins over its surface. Syphilitic bone lesions are usually multiple and painful and rarely as large as a cyst. Tuberculosis is also painful and tender and is attended by muscular atrophy. Chronic osteomyelitis would be accompanied by signs of inflammation and pain radiating in the diaphysis.

The roentgenogram gives a clear cut picture of a rarefied space near the end of a long bone, oval or fusiform in shape, with sharply defined border. It may seem to be merely an enlargement of the cortex.

Pathology. Grossly the cyst presents an intact periosteum, a thin cortex, and a cavity filled with brownish, more or less viscid, sero-hematogenous liquid. The cavity may be traversed by fibrous bands and its walls may have rough projections. The presence of a membrane lining the walls is doubtful. The liquid is sterile but contains numerous blood elements, lymphocytes predominating. Microscopically the cyst wall shows a vascular inner-layer of connective tissue, a bony middle layer containing osteoblasts and osteoclasts and an external layer corresponding to normal periosteum. Cartilaginous tissue has been noted by some observers. Myelocytes resembling giant cells have also been found in the medullary spaces. No evidence of bone forming or regenerative elements is found.

What is the nature of these cysts? Virchow concluded that they are the end result of a disintegrated enchondroma, the cartilage having come from the neighboring epiphysis. Some surgeons have regarded them as an attenuated form of sarcoma. They have been described as a localized form of Recklinghausen's disease, osteitis fibrosa cystica. The solitary cyst has much the same histology as the multiple cysts of that disease, but one great difference is that the single cyst is easily cured and Recklinghausen's disease is not.

There are three principle theories regarding the etiology; trophic, traumatic, inflammatory. The trophic theory seeks to explain the cyst as a dystrophy, not from nervous origin, but from disturbance of internal secretion. There is very little evidence in favor of this theory, either clinical or experimental. It might be easy to suppose a generalized osseous condition on an endocrine basis but not a sharply localized lesion.

Although a few instances are on record in which a cyst was discovered a year or more following a fracture, the theory of trauma is opposed by the fact that the overwhelming majority of fractures and other injuries are not followed by cyst formation.

The theory implies a central hematoma which in absorption results in a cavity. Further evidence against this theory is the lack of a history of trauma in most of the cases. Experiments on animals do not support the theory.

The inflammatory theory supposes a chronic periostitis followed by bone absorption. Staphylococcus albus has been found in a few cysts but in most cases the contents of the cavity is sterile. The author inclines somewhat toward the theory of syphilitic origin.

Treatment: Mikuliez evacuated the cavity and injected iodoform and glycerine. Others injected iodine. Resection beyond the cyst walls is not often done by modern surgeons. The aim should be to preserve a useful limb with as little mutilation as possible. It has seemed sufficient to enlarge the cavity by curettage. The cavity may be filled with bone wax, with paraffin, decalcified bone, free fat graft or muscle flap. All these methods have been employed by various surgeons. In cases with large cavities with not enough strong bone left for support, one must resort to resection, keeping in mind that shortening in an upper limb is not so serious as in a lower limb, and that the epiphyseal cartilage must be preserved. Autogenous bone grafts may be necessary after a resection.—*William Arthur Clark, M.D., Pasadena, Calif.*

A Case of Radio-Ulnar Synostosis, Bilateral and Congenital. Tristant. *Revue d' Orthopédie*, November, 1923, p. 489.

This is one of the more rare congenital deformities of the radius and ulna. Other more common deformities are absence of radius, luxation of radius, and flexion of the elbow. It is characterized by bony union of the radius and ulna at the point where they cross in pronation. Seventy-three cases have been reported.

The author's patient was a child of five who came to the clinic for an inguinal hernia. It was noticed that the boy did not use his hands in a normal manner. The forearms showed fixation in a moderate pronation but no deviation from the normal axis. The head of the radius could not be felt and there was no motion possible in the superior-ulnar articulation. The elbow joint was normal. The shoulder joint seemed abnormally mobile, probably to compensate for the limited rotation in the forearm. Musculature normal. Roentgenogram showed union of the radius and ulna near the proximal ends along an area about 2.5 cm. in extent.

Heredity is said to have some influence in etiology of this deformity. Other theories are: dystrophy due to syphilis, intra-uterine pressure, congenital dislocation, arrested development. A luxation of the radius is often associated with the synostosis. In this case the radial head was absent and the epitrochlea was undeveloped. The deformity is often bilateral and sometimes associated with synotosis of the distal ends as well.

The patient is usually more or less of a debilitated type. The only functional trouble is lack of rotation of the forearm. In diagnosis one must differentiate between old fracture with excess callus, contusion of the elbow, disease of the elbow. In posterior luxation there is usually free rotation of the forearm.

On account of compensatory movement in the shoulder and other adaptations the patient is not very much handicapped by this deformity. In the case described by the author the child was able to dress himself alone and use his hand for eating and drinking.

Surgical intervention is therefore not justified except in cases fixed in extreme pronation. When necessary, the bridge of bone is cut and soft tissue interposed. It

is necessary before breaking up the ankylosis to test the reaction of the supinator and pronator muscles to see if they have power to control rotation of the arm should the operation be successful.—*William Arthur Clark, M.D., Pasadena, Calif.*

THE POSTURAL INFLUENCE OF THE SYMPATHETIC INNERVATION OF VOLUNTARY MUSCLE. John J. Hunter. *The Medical Journal of Australia*, Jan. 26, 1924, p. 86.

Contractile and plastic tonus of normal and spastic muscles are discussed. In spastic muscles the increased contractile tonus leads to hyperactive tendon reflexes and confers a posture on the part. The increased plastic tone causes rigidity of the part. By severing the grey rami communicantes the rigidity can be removed. The special function of the sympathetic innervation of voluntary muscle is the maintenance of posture. This is also true in regard to blood vessels. In the hollow viscera the sympathetic innervation maintains appropriate relaxation of the walls and contraction of sphincters, while the para sympathetic stimulates the muscles of the walls and relaxes the sphincters.—*J. A. Key, M.D., Baltimore.*

OSTEOSYNTHESIS IN COMPOUND FRACTURES. END RESULTS. L. Grimault. *Archiv. Franco-Belges de Chir.*, Jan. 1924, p. 10.

In industrial surgery the author has practiced débridement of compound fractures and immediate osteosynthesis where necessary. Eight cases are reported in detail. Nails, bronze wire, and Parham bands were used for fixation.

From his experience he concludes that:

1. Compound fractures treated by surgical disinfection may be treated by immediate osteosynthesis, when the surgical disinfection in considered sufficient to permit an immediate closure.

2. In case one must leave a drain it is better to perform an osteosynthesis between the eighth and fifteenth days.

3. In infected wounds osteosynthesis should not be done if reduction can be maintained by other means.

4. A minimum of metal should be used.

5. It is not necessary to remove it unless there is local inflammation.—*J. A. Key, M.D., Baltimore.*

BILATERAL HIP DISLOCATION IN A FOETUS OF FIVE AND ONE-HALF MONTHS. M. Van Neck. *Arch. Franco-Belges de Chir.*, Jan., 1924.

This is the description of a specimen of unknown origin. The foetus is normal with the exception of the hips. Ossification of the femurs and pelvis is normal. The acetabula are small and shallow. The femoral heads are flattened but of normal size. There is no normal torsion or change in the angle of the femoral necks.—*J. A. Key, M.D., Baltimore.*

ARTHRITIS

DIFFERENTIAL DIAGNOSIS OF RHEUMATOID ARTHRITIS AS A CLINICAL ENTITY. Vincent Coates and R. G. Gordon. *British Medical Journal*, Sept. 29, 1923, p. 561.

The purpose of the investigation is to assist in differentiating true rheumatoid arthritis from other arthritides of non-specific origin which are vaguely classed as

"multiple non-specific infective arthritis," "focal arthritis," or "indeterminate arthritis."

The Etiology: A history of previous debilitating disease or prolonged physical strain is usual. Pyorrhea alverolaris, dental caries, and tonsillar infection are also very frequently present, but the authors feel that none of these can be held to be the only causative factor.

Dyspepsia, with constipation and flatulence, is a finding in nearly all cases, but it is unusual to find a definite lesion such as an inflamed gall bladder or appendix. The authors feel that the exact etiology is unknown.

Clinical features and course:

The predominant feature is swelling and pain in the joints, first in the small distal joints of the upper extremity, later perhaps involving larger joints, and symmetrical in distribution. The pathology consists in swelling of the synovial membrane and ligamentous structures around the joint, with rarefaction of the bone in the joint neighborhood. Later the ligaments become relaxed and abnormally mobile, and deviations occur.

There seems also to be a general metabolic upset involving the endocrine glands, particularly the thyroid. The lymph glands in the neighborhood of enlarged joints are involved. The blood shows a secondary anaemia with slight leucocytosis and a markedly increased percentage of small monoculears.

Examination of the gastric contents showed absence or diminution of free hydrochloric acid in eighty-five percent of cases, this finding being frequently, in the authors' opinion, the crucial factor in the whole picture.

The onset takes place usually at between twenty and thirty years of age, the disease progresses from joint to joint, with remissions, over a period of years and tends eventually to die out, leaving behind it deformed joints.

The authors offer as a tentative theory the production in the intestine of a toxin, by bacteria allowed to pass alive from the mouth through the stomach into the bowel because of absence from the stomach of free hydrochloric acid.—*E. N. Reed, M.D., Los Angeles, Calif.*

The Second Great Type of Chronic Arthritis. Leonard W. Ely. *Journ. Am. Med. Assn.*, Nov. 24, 1923, p. 1762.

This is Ely's fourth study on this subject.

The disease is characterized by bony outgrowths at the margins of the articular cartilages, at or about the lines of attachment of the capsule. It is of frequent occurrence and of ancient origin. The author states again that it occurs almost exclusively in persons who had infection in the alveolar processes of their jaws. It occurs most frequently in the fifth, sixth, and seventh decades of life but occasionally as early as the third decade.

In 38% of patients who submitted specimens, intestinal protozoa were found. One resected specimen contained no parasites. Ely believes that this type of chronic arthritis is due to some form of non bacterial organism, which, domiciled in the gastro-intestinal tract, gains access to the system through the foci of osteomyelitis about the roots of the teeth. The disease is best treated by removal of dead teeth and by the eradication of intestinal parasites.—*F. G. Hodgson, M.D., Atlanta, Ga.*

PNEUMOCOCCUS ARTHRITIS OF THE HIP WITH LUXATION IN INFANTS. Lamy. *La Presse Médicale*, September 5, 1923, p. 762.

In suppurative arthritis of the hip either luxations or pseudo-luxations may occur. This paper is concerned with the latter form. These pseudo-luxations arise from deformities of the joint. It has been thought that the deformities, especially of the acetabulum, are the result of erosion, but this theory does not explain all the facts. It is possible that sequestration of the acetabulum takes place.

In one case, a baby only a month old, there was an upward displacement of the great trochanter following incision and evacuation of pus (pure pneumococcus culture) from the hip joint. It would seem that erosion could not be an important factor in this case because of the rapidity with which the deformity appeared. It is more probable that the acetabulum was so changed and softened by the pus that it could not afford any support to the head of the femur.

The deformity due to the luxation is not noticed until the child begins to walk. The acute stage is so brief that it is forgotten and the possibility of bone destruction is not considered. This acute stage with abscess is often preceded by an attack of bronchopneumonia. There is high fever, extreme pain in the hip, and adduction of the thigh. Swelling soon appears and incision or spontaneous rupture yields a large quantity of pus.

In another case a child had had an abscess in the left hip, which on incision yielded pus containing numerous pneumococci. Nothing more was noticed until at 16 months, when beginning to walk, the child limped. Examination then showed shortening of left leg and loss of femoral head. The acetabulum, however, appeared perfectly normal, proving in this case at least that erosion had nothing to do with disappearance of the femoral head.

Such cases may be mistaken for congenital dislocation, but because of amplitude of motion and sound condition of the acetabulum they can not be confused with tuberculosis.

Treatment should have for its aim the replacement of the stump of the femoral head in the acetabulum. Even if this is successful, an unavoidable limp usually persists.—*William Arthur Clark, M.D., Pasadena, Calif.*

PROTEIN THERAPY: ITS USE IN CHRONIC INFECTIOUS ARTHRITIS. J. C. Middleton, *Glasgow Med. Journal*, Sept., 1923, p. 124.

Middleton records the results in ten patients suffering from rheumatoid arthritis and allied conditions. Six were males and four were females, the average age being 40 years.

Bacillus coli in doses of 50,000,000 bacilli, and bacillus typhosus in doses of 100,000,000 bacilli were given. The temperature reaction varied from 101 degrees to 104.8 degrees, and lasted as a rule about 24 hours. No serious effects were felt in any of the cases and definite improvement was recorded in most of them. Few, however, were of the severe bed ridden type where we need help most.—*Charles C. Parker, M.D., Chicago.*

SYNOVECTOMY OF THE KNEE JOINT IN CHRONIC ARTHRITIS. Ellis Jones. *Jour. Am. Med. Assn.*, Nov. 10, 1923.

This procedure is offered in selected cases of chronic knee joint arthritis.

Arthritis deformans, pyogenic arthritis, and the acutely proliferative type of so called atrophic arthritis positively contraindicate synovectomy. The author uses the split patellar incision as it permits of immediate post operative mobilization. Full function is usual at the sixth week. Twelve cases are reported.—*Edward S. Hatch, M.D., New Orleans, La.*

FURTHER OBSERVATIONS ON ARTHRITIS AND RHEUMATOID CONDITIONS. Ralph Pemberton. *Am. Jour. Med. Sciences*, Dec., 1923, p. 833.

Many of the cases of arthritis are precipitated by streptococci and other organisms acting through so-called focal infections; other cases are apparently precipitated by different factors, and in any event the mechanism concerned in the production of the symptoms and lesions has remained entirely obscure. Definitely lowered sugar tolerance is most marked in general in the worst cases of arthritis. The lowered sugar tolerance was uninfluenced by such agents as the salicylates. The percentage of oxygen saturation rises markedly during an electrical bake of the whole body. Experiments show blood flow in arthritis, in the capillary circulation especially, may be below normal. The experimenters observed many other points, that the condition of sore muscles popularly known as "Charley horse" which arises more easily is arthritics than in normals, followed a smaller amount of exercise than is the case at low levels, and they also noted that acclimatization was frequently accompanied by an enlargement of the ends of the fingers, suggesting the condition known as hypertrophic pulmonary osteoarthropathy. The periods of greatest malaise of the arthritic are following rest in the early morning hours (four to five A. M.), at which time the body temperature is lowest. The clinical state of the patient generally improves as the day wears on, and toward six to seven P. M. opposite conditions prevail, accompanied by parallel oscillation of the metabolic rate, as shown by the elimination of carbon dioxide. Exercise, in general, is of benefit to rheumatoid conditions. The increased elimination of CO_2 and the increased blood flow which accompany it are probably analogous to those resulting from bakes. The evidence is at least suggestive that something interferes with the utilization of oxygen or its removal from the peripheral blood, some disturbance of the capillary or finer vascular control, absorption and deposition of bony tissue, and are partly functions of changes in the gas equilibria at the part concerned. It is possible that the pannus which covers the joint cartilage in the proliferative form of arthritis and the formation of fibrous tissue so frequently seen in arthritis is in part a compensatory phenomenon seeking to vascularize the affected region with the aim of supplying adequate nutrition. Anemia is a sequel of chronic arthritis which tends greatly to aggravate the disease process. An improvement has been noticed with a rise in the red count. It is important to note that nearly all measures of benefit *per se* in arthritis and rheumatism depend upon an increased local or systemic metabolism or upon an increased local or systemic blood flow. Theoretical considerations suggest and practical experience has shown that the climatic conditions best suited to arthritis are those characterized by a reasonable degree of altitude, a thousand feet or so, a dry soil, and a dry atmosphere.—*Voight Mooney, M.D., Pittsburgh, Pa.*

PARALYTIC DEFORMITIES

THE TREATMENT OF ACUTE POLIOMYELITIS: PRELIMINARY NOTE ON USE OF HYPERTONIC SALT SOLUTION AND CONVALESCENT SERUM. William Lloyd Aycock and Harold L. Amoss, *Jour. Am. Med. Assn.*, Aug. 11, 1923.

"Poliomyelitic monkeys given convalescent human serum intraspinally and intravenously, and hypertonic salt solution intravenously, exhibited marked improvement as compared to controls. By the shrinking of the central nervous tissues after intravenous injection of hypertonic salt solution, more space is available in the subarachnoid space for the reception of large amounts of serum; this is especially advantageous, since the convalescent serum is at best weak in antibody content, and correspondingly larger amounts must be injected. The beneficent effect of the change in tonicity of the blood, with the marked decrease in the volume of the brain and spinal cord, is to reduce the inflammatory edema of the cord."

"The third and probably the main possibility of a beneficent effect of such a method lies in the fact that the intravenous injection of hypertonic solution brings about an aspiration of serum from the subarachnoid space into the perivascular system, thus insuring a more intimate contact between the main lesions of the poliomyelitis and the serum, which can be regarded as a distinct advantage in local specific therapy."—*Edward S. Hatch, M.D., New Orleans, La.*

OPERATIVE TREATMENT OF PERIPHERAL PARALYSIS (POLIOMYELITIS AND NERVE INJURIES) THROUGH THE TRANSFERENCE OF POWER OF A HEALTHY TO A PARALYZED MUSCLE BY MEANS OF A NEWLY FORMED TENDON. Katzenstein. *Med. Klinik.* January 13, 1924, p. 41.

The nature of this operation consists in the utilization of power of a muscle situated above the sphere of paralysis, *i.e.* in a higher "storey" and in the avoidance of splitting this muscle. Out of fascia or skin a new tendon is formed which is connected above with the disperser of power, the active muscle, and is attached below to the paralyzed muscle or group of muscles. The contraction of the disperser-muscle will be transmitted by means of the artificial tendon to the paralyzed musculature. The choice of the corresponding power disperser will result in an automatic action of the activated joint, and no re-education of muscle, as in the old methods, would be required. The operation has been performed 30 times in 28 cases, and has proven very satisfactory in reestablishing function of the paralyzed limb. Among the cases quoted are: paralysis of the facial nerve, the radial, and the sciatics, and poliomyelitic paralysis of the peroneal muscles, the tibialis group, and one case with total paralysis of the thigh and leg muscles.—*A Gottlieb, M.D., Los Angeles, Calif.*

AMPUTATION IN CASES OF ANTERIOR POLIOMYELITIS. E. Muirhead Little. *British Med. Jour.*, Feb. 16, 1924, p. 292.

During the last three or four years amputation of the thigh in cases of extensive infantile paralysis has been performed much more frequently than was the case before the war.

This is justifiable when undertaken for septic ulceration or gangrene, but it is seldom that a prosthetic appliance improves function. A case is recorded of amputation

through the condyles in which all the muscles attached to the femur were hopelessly paralyzed. Even the flail limb can be benefited by stabilizing operations, supplemented by the use of walking instruments; this is much more forcibly the case when some active muscles remain. Amputation should on no account be done unless the surgeon is "very sure indeed" that in the end his patient will be better off.—*Alexander Gibson, M.D., Ch.B., Winnipeg.*

THE EARLY MECHANICAL TREATMENT OF POLIOMYELITIS. Harry Platt. *British Med. Journ.*, Feb. 16, 1924, p. 266.

Most sufferers from poliomyelitis can be made to walk provided they can hold crutches. Surgical intervention in the later stages can often be avoided if attention be paid to the prevention of deformities during the early stages. There has been, during recent years, a distinct advance in early treatment, largely due to the work of American observers.

A description is given of clinical stages.

(1) The acute stage four to six weeks.
(2) The recovery stage, to the end of the second year.
(3) The chronic stage, from the third year onward.

Treatment follows certain fundamental principles.

(1) Complete rest. This may be secured by plaster of Paris, or by the use of a padded spinal frame.
(2) The prevention of deformity.
This is obtained by the use of certain standard position for the limbs.
(3) Relaxation of the paralyzed muscles.
This may involve a compromise when the paralysis is wide-spread.

Unremitting care is required even after the stage of recovery is reached, for deformities may develop after walking has begun.—*Alexander Gibson, M.B., Ch.B., Winnipeg.*

RICKETS

ACUTE RICKETS IN LATE CHILDHOOD AND ADOLESCENCE. E. Laming Evans. *British Med. Journ.*, Dec. 22, 1923, p. 1212.

The essential feature of rickets is a disturbance in the metabolism of the growing organism in which the calcium and phosphorus in the circulating fluid are unbalanced, in consequence of which calcium is no longer deposited in bone.

Hess has pointed out a seasonal variation in the calcium and phosphorus contents of the blood corresponding to the seasonal variations in the occurrence of rickets. The changes at the ends of the long bones are characteristic. The epiphysis shows a cloudy area containing one or more ill-defined centres of ossification. The diaphyseal end is ragged and broadened.

The premature child is peculiarly susceptible to rickets even when well breast-fed. Children born in the Autumn are more liable to rickets than children born in the Spring.

Two factors appear to regulate salt absorption by bone-tissue.

(a) A factor X generally associated with fat-soluble vitamin A. Codliver oil contains A and X abundantly.

(b) Radiant energy present in the solar spectrum and emanations from mercury-vapor quartz lamp.

Two cases of late rickets are described.

Boy 7½, eight months child, not breast-fed. Epiphyses showed enlargement. Under treatment for six months; cure appeared to be under way.

Girl 14½. Had suffered from poliomyelitis in infancy. Under treatment for six months; considerable improvement.

It is concluded that late rickets is produced by the same agents as infantile rickets, an insufficiency of factor X or radiant energy or both, and that it can be cured by the addition of these to the diet or environment.—*Alexander Gibson, M.B., Ch.B., Winnipeg.*

REPORT OF 166 OPERATIONS FOR RACHITIC DEFORMITIES. E. Sorrel and H. Oberthur. *Revue d'orthopédie*, July, 1923, p. 303.

Indications for operative correction are interference with function or very bad esthetic appearance. It is usually not necessary to operate before six years of age. The clinical signs of rickets in evolution should be entirely gone. This may be as late as nine years. The authors' cases averaged six and one-half years, the youngest being four and the oldest fourteen at operation. The best criterion of the end of the clinical stage is the roentgenogram. The shaft of the bone should show intense recalcification after having been decalcified and the epiphyses should have lost their globular appearance and become more normal in appearance.

FEMORAL DEFORMITIES.

For genu valgum there are three forms of osteotomy: transverse supracondylar, cuneiform supracondylar, and vertical tran-condylar. Although the transverse method has been said to be the only method necessary in any case, it has been found that it is not suitable for extreme deformities because the fragments, instead of moving as a hinge as they are supposed to do, really are crushed one into the other on the side where the pressure of correction comes.

When the deformity is bilateral it is best to operate on one side at a time. The second side should wait until the cast is off the first side and fair movement is established without pain, which is usually in about two months. Incision is made on the mesial aspect for the transverse osteotomy and only one osteotome is used. A slight degree of over correction is established and a spica cast applied. For the cuneiform type the incision is larger in order to permit the use of an electric saw. The size of the wedge to be removed varies with the degree of deformity and is easily judged after a little experience. The electric saw is far superior to an osteotome, since it makes a clean cut with very little hemorrhage. The approach for vertical intercondylar osteotomy is more anterior than that for the cuneiform and conforms to the curve of the mesial condyle. This condyle is detached with saw and chisel in an almost vertical antero-posterior plane. When the correction is made the condyle slips upward along the inner surface of the femur. There is usually quite a little stiffness in the joint for several days after removal of the cast following this method, but the final result is always good.

Varus deformities, while giving a bad appearance, do not interfere with function so much as the valgus types. If the curve is severe it is best corrected by supra-condylar transverse osteotomy. Some cases have the apex of the curve in the middle third of the femur and must be cut at that point.

TIBIAL DEFORMITIES.

A simple curve in one plane as varus or valgus is very rare in the tibia. There is usually a complex curve, a forward or backward bend in addition to the lateral bend. A torsion frequently adds to the complexity. The authors have never found a case that could not be corrected in all its complexities by cuneiform osteotomy. There is no shortening by this method; whatever length is lost by removal of the wedge is compensated by straightening the curve. It is necessary to study the roentgenograms carefully to determine the site of the osteotomy and the thickness of the wedge to be removed. Incision is made a little outside the tibial crest, the periosteum is retracted and the wedge cut with an electric saw. It is best always to fracture the fibula, even though it seems malleable, because it acts as a splint and interferes with best results. Plaster cast is applied including the pelvis, for one cannot be sure of complete immobilization of the knee if the cast goes only to mid-thigh. It should not be too tight because the leg always swells after this operation. One variation in technique consists in doing a transverse osteotomy, then modeling the ends, one concave the other convex, by means of the saw attachments. The ends then fit together and permit reduction of the deformity in all directions without displacement. The name "modeling osteotomy" is proposed for this method.

It may be necessary in rare cases to do four osteotomies on one patient; each femur and tibia being involved. One osteotomy should be done at a time in such cases, beginning with the greatest deformity.

The 166 operations which form the basis of this paper were done on 101 patients. Of thirty-three cases with unilateral knock knee, thirty-one had transverse osteotomy and two cuneiform. There were twenty-six children with double knock knee, the fifty-two deformities of which were corrected by transverse (46) and cuneiform supracondylar osteotomies (6). Thirty-one children had tibial deformities alone, ten unilateral, twenty-one bilateral, totalling fifty-two deformities, forty-four cuneiform and eight modeling osteotomies. The remaining six cases had miscellaneous deformities, two of which were of the forearm.—*William Arthur Clark, M.D., Pasadena, Calif.*

FEET AND POSTURE

KOEHLER'S DISEASE OF THE SECOND METATARSAL. Altschul. *Med. Klinik*, Jan. 3, 1924, p. 42.

Based upon 42 previously published and 5 additional cases of the author, he gives the following interpretation of the mode of development of this affection: Through change of static relations the second metatarsal head is exposed to greater pressure. By this means pressure necrosis takes place in the epiphysis, which eventually collapses. Following this, a regenerative process of the metaphyseal periosteum takes place and leads to a rebuilding of the epiphysis. The exuberance of the metaphyseal periosteum spreads also diaphyseally and results in a thickening of the diaphysis. It is, however, possible that in these cases a constitutional weakness of bone predisposes to the affection.—*A. Gottlieb, M.D., Los Angeles, Calif.*

KOHLER'S DISEASE OF THE TARSAL SCAPHOID. H. H. Greenwood. *Lancet*, Aug. 11, 1923, p. 274.

Köhler showed his first three cases of this disease at Wiesbaden in 1908 and published an account of them. In 1915 when he reviewed the subject there were only 26; since that time additional cases have been described by Maynard Heath, O'Brien, Hetzel, Moreau, Roederer, Beltrandi, but the disease must still be considered to be comparatively rare. The symptoms and physical signs are not obtrusive, spontaneous recovery seems to be the rule, and the diagnosis rests on the characteristic roentgenographic appearances. It is probable, therefore, that the disease often escapes detection and that it is more common than the records indicate. The clinical picture is fairly clear-cut, although in details there are some differences of opinion.

CLINICAL PICTURE. The disease occurs in young children, more frequently in boys, between the ages of three and ten years. The onset is usually insidious, sometimes sudden, with pain and swelling in the region of the tarsal scaphoid. While it is generally unilateral, both feet are sometimes affected. The general health is usually indifferently good. The child develops a limp and shows more or less tendency to flat foot. Spontaneous recovery always occurs, so far as present records show, in from 6 to 12 months from the date of diagnosis. The ultimate diagnosis rests on X-ray findings. On these, but not on the general interpretation, there seems to be a general agreement. They are as follows:

(1) The affected bone is smaller than normal (half to quarter size); (2) the outline of the bone is irregular (Köhler omits to mention this fact); (3) the density of the bone is increased (estimated at two to four times); (4) the normal architecture of the bony trabeculae has disappeared. To these may be added (5) the general shape of the scaphoid is altered, being more flattened from before back and not widened from side to side.

ETIOLOGY. When we consider the etiology we find considerable diversity of opinion. The attempts to find analogies in Madelung's deformity of the wrist-joint, in Perthes' disease, in Schlatter's disease of the tibial tubercle, would be more helpful if the etiology of these affections were less speculative.

QUESTION OF TUBERCULOSIS. Although most authorities demur on account of the clinical course of the disease, and Hetzel found the von Pirquet reaction negative, the new evidence warrants a review of the clinical data and roentgenographic appearances, none of which is incompatible with this theory. Roederer, reviewing the subject in 1920, asserts confidently that "les deux sexes sont indifferement atteints." Again he says "aucun de ses enfants n'est tuberculeux." As to the positive grounds, that upon which the assertion that all the patients were free from tuberculosis is based there is no evidence. Parental tubercular infection plays a more conspicuous part in the recorded cases that Roederer admits. In Maynard Heath's case the father was tuberculous.

In reviewing the cases recorded in the literature it is certain that no real *causa causans* emerges from the theory of dystrophy "or delay in ossification," later "stimulated to osteogenesis by trauma." Indeed, a history of trauma could probably be obtained in every case in parents of average intelligence and memory.—*Thomas Madden Foley, M.D., Washington, D.C.*

MAN'S POSTURE, ITS EVOLUTION AND DISORDERS. Sir Arthur Keith. *British Med. Journ.*, March 24, 31, April 7, 14, 21, 1923.

Keith, after prolonged observations in the Orient, and as curator of the Museum of the Royal College of Surgeons, presents in the Hunterian Lectures a most interesting study of human posture and its evolution. It is based on anatomic and physiologic studies of the pronograde and orthograde apes, and man. The fact is emphasized that of necessity any changes in the physiology of the animal cause alterations in the nervous, bony, and muscular structures, and secondary changes in other organs.

CHANGES IN THE SPINE. In the ascent from the highest pronograde monkeys to man the sacrum, which is composed originally of the 27th, 28th, and 29th segments, is gradually enlarged by the inclusion of the lumbar segments so that eventually in man we have the sacrum made up of the 26th, 27th, 28th, and 29th segments, and the number of lumbar vertebrae is correspondingly decreased from seven to five. Man, the most highly evolved, has the most stable lumbo-sacral formula. This gradual sacralization of the lumbar spine has been accompanied by a gradual migration of the limb buds headward. Likewise, there has occurred a change in the region of the dorso-lumbar junction. The last rib in the pronograde is attached to the 20th vertebrae, as thirteen pairs of ribs are present. In the fully developed human, the last rib is attached to the 19th vertebra, and twelve pairs of ribs are present, whereas embryologically, there are thirteen pairs of ribs, and the diaphragm remains attached to the first lumbar or 20th vertebra, which corresponds to the thirteen pairs of ribs. Why were these changes accomplished? In the pronograde monkeys the lumbar spine constituted from 40 to 45 per cent of the pre-sacral spine; in the orthograde apes, 30 to 35 percent is found in this same region; from 24 to 30 percent in the anthropoid apes, while in the human at birth, 27 percent is found here. With the onset of walking an elongation occurs in the lumbar region, so that finally 32 per cent of the pre-sacral spine in man is lumbar in character. This elongation is concomitant with the appearance of the lumbar curve—a human characteristic. Furthermore, the erector spinae muscles in the orthograde apes weigh less than one half of what the corresponding group in a somewhat smaller pronograde monkey weighs; hence he concludes that the shortening of the lumbar spine and the elongation of the sacral spine is brought about for the sake of muscular economy. The following facts are noted in connection with these alterations of structure: (1) the tail becomes coccygealized before a species assumes the orthograde posture; (2) the sacralization of the sixth and seventh lumbar vertebrae increases the area for muscular attachment, and also strengthens the area of spinal fixation; (3) in man, there is an enormous increase in the flare of the iliac crests dorsally; (4) the effective sacral area is further increased by the backward tilting of the sacrum.

Lateral stabilization of the spine is brought about by alterations in the ribs and the shape of the thorax. The ribs are divided into three segments; (1) dorsal, which becomes longer and set further back, thereby giving a larger and more effective attachment for the erector spinae group; (2) lateral, to which the intercostal and the oblique muscles are attached; (3) ventral, which is acted on by the rectus abdominis. With these changes a modification of both the quadratus lumborum and the multifidius spinae occur, in that they change from a series of small fasciculi acting from vertebra to vertebra, to large muscle sheets, acting on the ilium, transverse processes, and the last rib.

CHANGES OCCURRING IN THE THORAX AND SHOULDERS. These alterations occur chiefly on the assumption of the orthograde position. In the prono-

grade monkeys the thorax is flattened from side to side, the scapulae are located laterally, the sternum is made up of several small jointed segments, and the trunk is supported by the fore limbs through muscle slings made up of (1) the serratus magnus and the levator angular scapulae, (2) the pectoralis major, minor, and externus. In order to prevent the flaring of the posterior border of the scapulae certain dorsal slings are introduced, made up of trapezius, rhomboid, and latissimus dorsi. With the assumption of the orthograde posture and the use of the arms for progression, as in the Gibbon, the following changes are found: (1) the dorsal sling is very much modified, the latissiums dorsi becoming attached to the side of the pelvis; (2) as the animal hangs from his hands, the chest is compressed between the anterior and posterior slings, resulting in a drawing up of the ribs, and the shoulders are drawn outward and backward; (3) migration of the muscles occurs as follows,—the pectoralis major is extended to the clavicle, and laterally reaches the 5th and 6th costal cartilages, the pectoralis minor is shifted laterally from the sternum to the costal cartilages; (4) the sternum becomes fused a broad flat plate; (5) thoracic breathing becomes the rule; (6) in the chimpanzee, gorilla, and man, interchondral facets develop between the 5th and 6th, and the 6th and 7th costal cartilages. This is necessitated by the development of an elbow in the 5th costal cartilage, and permits the diaphragm to raise not only the lower six ribs but the sternum as well. It is to be observed that the first rib and manubrium remain practically stationary,—except as the sternum is raised an angulation occurs at this joint. He makes the interesting observation that in the gibbon and orangotang no facets exist and these individuals become pigeon chested. (7) The thoracic breathing is further aided by a migration of the recti from this attachment to the upper four ribs, and a similar migration of the external, oblique, and scalaneus medius to their present position. (8) The diaphragm changes from the oblique to the horizontal position, the central tendon becoming cordiform; the crural fibers migrate to the sheaths of the psoas and quadratus lumborum, thereby obliterating a space between the costal and crural fibers which exist in the pronograde. (9) The vena cava is shortened from a super diaphragmatic length of two inches to its human form. (10) Azygos diverticula of the right pleura together with a corresponding lobe of the right lung, disappears from between the pericardium and the diaphragm. (11) The pericardium becomes attached to the diaphragm, and the heart changes to the blunt form found in man. (12) These changes permit of an increased development of the apical portion of the lungs which necessitates certain changes in the bronchi and the larger blood vessels. (13) In man, the levator claviculae becomes vestigial and a ptosis of the shoulder and chest occurs in the transition from childhood to adult life with a decrease of antero-posterior chest diameter.

ADAPTIONS IN THE ABDOMEN AND VISCERA. In the living individual the viscera have a normal range of motion from ½ to ¾ inch, whereas in the dead, the range is from three to five inches. Keith concludes that this evidence shows that the viscera are not held in position by the mesentery, but by the muscles of the abdominal wall, particularly the transversalis; the other anterior abdominal muscles are really part of the spinal mechanism. One finds in the ascent from the pronograde that the area of visceral fixation becomes more extensive and closer, apparently for the purpose of limiting motion and preventing angulations. With the shortening of the lumbar spine mesenteric attachments become shorter, the recesses on either side of the spinal column become deeper, and the viscera contained in these recesses do not receive direct muscle support from the abdominal walls.

POSTURAL MODIFICATIONS. Postural modifications of the pelvis, perineum and groin: this lecture contains very little of interest to the orthopaedic surgeon, but is worthy of careful consideration by the general surgeon and gynecologist.

EVOLUTION OF THE FOOT. The great gap in the development of the foot lies between man and the anthropoid apes. Regardless of the development of the ape, the great toe remains separated as in the hand. In man alone is the first metatarsal fused closely to the remaining metatarsals. The evidence would go to show that the human type is an atavistic one, although other evidence points to the fact that the human foot has passed through a prehensile stage. In the monkey, the three contrahentes muscles approximate the metatarsal head, whereas in the human foot these muscles are represented by fibrous bands, and they are degenerate too in some of the higher apes. In monkeys the interossei lie on the plantar surface of the foot, as is true also in the human embryo. Later in the human, they migrate to their customary position. In the infant's foot, the flexion line corresponds to those of the gorilla, his foot is inverted as in the apes, and represents an adaptation for climbing and grasping. Again the articular face of the internal cuneiform is set obliquely, recalling the prehensile use of the great toe. The astragalus in the infant likewise corresponds to the astragalus of the anthropoid apes. In man the short flexor of the great toe has a second belly. Embryologically a prehensile great toe is not seen in man, whereas the human type of foot is forshadowed in the embryo of the ape. In the ascent from monkeys, the proportion of the foot given over to metatarsus has remained constant, the tarsal portion has been increased at the expense of the phalangeal. In the great toe, however, there has been an increase in the metatarsophalangeal length as compared with the longest toe of the anthropoid type, so that the great toe now becomes the longest portion of the foot—a modification apparently for the sake of propulsion. The mid-tarsal joints of the apes are fairly mobile, but as the ascent is made, this flexibility disappears. No plantar arch is found in the apes, although in the gorilla the foot is held inverted while standing, and it would apparently mark the beginning of the plantar arch. The fusion of the first metatarsal into the foot, and the beginning of the use of the tibials for postural work have caused the arch to appear. The heel gait is characteristic of the ape as well as man, and the abducted great toe is used in push off as in man. In the process of fusion, the metatarsal of the great toe has become abducted, as is evidenced by the change in line of axes as compared with the axis of the calcaneum. In the evolution of the arch, the plantaris is lost early, the short flexors of the toes gradually migrate from a tendon of the long flexors to a point where all short flexors arise from the heel. The quadratus plantae develops an inner belly. This, together with the new position of the interossei, tends to strengthen the plantar arch. These changes have been accompanied by a strengthening of the internal lateral ligaments of the ankle joint. The insertion of the anterior and posterior tibial muscles have been modified, the peroneus tertius appears only in man. The great toe lies between one of two normals, first a line drawn from the inner side of the heel through the head of the first metatarsal and the other side of the angle is formed by a line drawn through the outer side of the heel and the fifth metatarsal. It would therefore appear that so-called flatfoot is a reversion to an earlier type.—*Steele C. Stewart, M.D., Los Angeles, Calif.*

CORRECTION OF EXTREME FLATFOOT (GLEICH OPERATION). J. P. Lord. *Jour. Am. Med. Assn.*, Nov. 3, 1923.

The object of this operation is to so change the alignment of weight bearing as to

shift the center of gravity inward and then throw the direction of the body weight outside the center of the foot.

This is done by making a curved incision a finger's breadth behind the external malleolus. A thin broad chisel is then driven obliquely through the bone. The posterior portion is displaced inward the required distance and a plaster cast applied. Fourteen cases are reported, all but one of which had various other corrective operations done which were indicated in each case.—*Edward S. Hatch, M.D., New Orleans, La.*

An Operative Method for Correction of Certain Forms of Flatfoot. C. L. Lowman. *Jour. Am. Med. Assn.*, Nov. 3, 1922.

The operation is advised for flatfeet in which preventive and corrective measures have been carefully tried without success, and it seems to be an excellent procedure.

Method of operating: "A curved incision is made base downward, extending from just below the inner malleolus upward and forward to a point above the scaphoid, and thence forward and downward to a point on the inner aspect of the base of the first metatarsal. The skin flap is dissected back, and a straight incision is made through the fascia, which is separated by a blunt dissection well down below the tip of the scaphoid, exposing the inner edge of the calcaneonavicular ligament. The astragaloscaphoid ligament is incised in line with the joint, and the outer end of the scaphoid is denuded of its periosteum, with all ligamentous attachments. The Achilles tendon is tenotomized and the foot is forced upward to lower the posterior end of the os calcis. Next a wedge is excised chiefly at the expense of the scaphoid, a fair piece also being taken from the head of the astragalus, based downward and inward. It is deepened sufficiently to relieve all obstruction to adduction and depression of the forefoot for the formation of a satisfactory arch. If the Achilles tendon is too much shortened, it is lengthened rather than tenotomized. Next, if it is a simple nonparalytic flatfoot with fairly strong tibials and not much overaction of the peronei, the latter are simply tenotomized. Then the anterior tibial is isolated down to its attachment, and is displaced with a curved instrument or blunt hook, inward and downward until it slips under the squared-off corner of the scaphoid, thus passing through the opening made by the osteotomy. It is not detached, however, but its direction is altered so that, in pulling upward, it raises the scaphoid or keystone upward, assisting in forming an arch, rather than deforming it, as it had been doing previously.

"The displaced tendon of the anterior tibial should be grasped with long forceps and held down under the scaphoid while the operator places a deep suture of kangaroo tendon strongly into the middle of the calcaneonavicular ligament under the gap of the osteotomy opening; next this is brought up and passed around, not through the anterior tibial tendon, the assistant making strong correction of the arch while it is being tied. This position must be maintained while a couple of strong chromic sutures are placed through the margin of the cut astragaloscaphoid ligament laterally. When these are strongly approximated or imbricated, the foot will remain in fairly good position, which, of course, is improved to its maximum, while the cast is put on.—*Edward S. Hatch, M.D., New Orleans, La.*

DEFORMITIES OF THE OS CALCIS. T. H. Openshaw. *British Med. Journ.*, Dec. 22, 1923, p. 1214.

A. *The Result of Traumatism.*

1. *Oblique Posterior Fracture.* The posterior fragment is pulled up by the tendo Achillis. Unless the tendo Achillis is fully relaxed by bending the knee and putting the foot in the equinus position it is very difficult to replace the fragments and retain the posterior fragment in accurate position.

2. *Compression Fracture.* Often the bone is expanded laterally. It is this lateral expansion which may cause pain and discomfort. Pain is felt in front of the external malleolus and may persist for years. Removal of the projecting surface of the os calcis cures the patient at once.

3. *Comminuted Fracture.* The under surface of the os calcis often presents an irregular mass of bone projecting into the sole of the foot. Chiselling off these projections brings about a perfect cure.

B. *Congenital Defect.*

Overgrowth of the Great Process of the Os Calcis. This is present in every severe case of congenital equinovarus. It can be rectified by removal of the great process, sometimes with a part of the adjacent cuboid.

Overgrowth of the outer wall of the Os Calcis. This is met with only in the most severe cases of long standing congenital equinovarus.

To remedy this, it is necessary to open the talo-calcanean joint and remove a portion of the upper and outer surfaces of the os calcis.

C. *Disease.*

Spurs on the inferior Surface. This deformity "an overgrowth of the tubercle on the under surface of the os calcis" leads to considerable difficulty in walking. These tubercles should be thoroughly removed, otherwise recurrence of the disability is not prevented.

Overgrowth of the Epiphysis. Constant violent contraction of the tendo Achillis stimulates and causes an overgrowth of cartilage or bone at this part.

When the enlargement causes such an amount of inconvenience as to interfere with the comfort of the patient, the osteophytic outgrowth should be removed.—*Alexander Gibson, M.B., Ch. B., Winnipeg.*

SCOLIOSIS.

VERTEBRAL DEFORMITIES.

THE ORTHOPAEDIC TREATMENT OF SYMPTOMATIC SCIATICA. Philip Lewin. *Journal American Medical Association*, March 22, 1924, p. 965.

Dr. Lewin keeps his patient in bed with a Buck's traction apparatus on the affected side and 10 lbs. of weight. When all pain and sensitiveness disappears a plaster spica from ribs to mid-calf is applied and the patient gets about with a high-soled shoe on the well side and crutches. In six weeks a "sacro-iliac belt with thigh pants" is substituted for the spica.—*H. A. Pingree, M.D., Portland, Maine.*

CORRECTION OF STRUCTURAL LATERAL CURVATURE OF THE SPINE. R. W. Lovett and A. H. Brewster. *Journal American Medical Association*, April 5, 1924, p. 1,115.

The authors describe the making of a plaster of Paris corset for corrective and retentive purposes. Essentially it is a long corset extending from trochanters to axillae. It is cut up the front and fitted with straps and buckles so that it may be applied and removed. An iron turn-buckle with its bases at the top and bottom is rivetted on the convex side. A strap hinge with its pinion at the apex of the deformity is applied on the same side. The corset is now sawn from side to side through the apex. By means of the turn-buckle the corset becomes concave on the side in which it was formerly convex and vice versa. A strap with hinge at the bottom and a peg and slot at the top, on the side opposite the turn-buckle serves to lock and retain any gains made.

There are five excellent illustrations. From an inspection of these it would appear that the apparatus is an effective one in side bending so long as the apex of a single long curve is located near the center of the trunk. There is no provision made for rotation of the ribs or for the presence of a double curve.

The authors' list of points in its favor is quoted below.

1. It effects mobilization of the spine.
2. The force applied spreads the ends of the arch and does not disregard the mechanical law that the keystone is the strongest part of the arch.
3. It permits of gradual correction.
4. It will produce an immediate correction in moderate curves, as described above.
5. It tends at the same time to decrease rotation as seen clinically and in the roentgenograms.
6. It stretches out the shortened structures on the concave side of the curve.
7. It allows the stretched structures of the convex side to regain their tone.
8. It furnishes a means of securing an adjustable overcorrective retention jacket.
9. It increases the patient's height.
10. It is not uncomfortable.—*H. A. Pingree, M.D., Portland, Maine.*

THE TABETIC SPINE. Henri Roger. *Paris Médical*, Nov. 24, 1923.

The writer notes the appearance of bone and joint changes (spontaneous fractures, Charcot joints) in tabetics, and considers that not sufficient importance has been given to their vertebral changes, six cases of which he reports. A typical case will show a gradual onset of lumbar deformity, kyphosis with scoliosis, generally without pain, but not necessarily so. The vertebral deformity is usually discovered late and often by accident. At times it is accompanied by crepitus in the affected area. The tabes itself has as a rule become well developed. The spine is freely movable at the affected area, and as a rule little or no pain is elicited by palpation or percussion. The presence of free movement at the site of lumbar deformity is looked upon as a pathognomonic sign. The roentgenograms show an interesting association (as in other tabetic arthropathies) of destruction and proliferation in the lumbar spine, the bodies of the third and fourth vertebrae being most often attacked. These show irregular destruction leading to lateral and antero-posterior deformities, with marked bony proliferation appearing laterally above and below, where the vertebral bodies are in apposition. The affected area may as a result show great enlargement in the roentgenograms, accompanied by evidences of tabes, such findings may be considered pathognomonic. Accessory symptoms are pain in abdomen and legs, with hypaesthesia, etc. The writer attributes

much of the pain to osteophytic compression of the nerve roots, but never to medullary irritation or compression. As the disease progresses the patient becomes more and more humpbacked, while the gait reveals the incoördination of the tabetic. Treatment.—Anti-syphilitic medication is indicated, as well as a plaster jacket or other immobilizing apparatus in early cases. When the deformity has become fixed, this latter will be of little service. In the case of vertebral deformity of sudden onset following mild traumatism, it is well to suspect spontaneous fracture of a tabetic spine and to search for the usual evidences of tabes (loss of knee jerks, lightning pains, and Argyll-Robertson pupil).—*J. Appleton Nutter, M.D., Montreal.*

Fusion in Scoliosis. H. B. Thomas. *Journal American Medical Association*, Nov. 10, 1923.

The writer describes the methods of Albee and Hibbs and the MacLennon method of fusion and then describes the anatomy of natural fusions and his use of the osteoperiosteal graft. He promises to give his results in a later paper.—*Edward S. Hatch, M.D., New Orleans, La.*

The Lumbosacral Region. H. L. von Lackum. *Journal American Medical Association*, April 5, 1924, p. 1,109.

The author discusses the various normal conditions as well as some of the anomalies as observed in the examination of 30 cadavers, of which five were female. The paper is illustrated by cuts of sagittal sections of the several lumbar spines and sacra as removed from the bodies. There are also seven skiagrams. It is evident that the points clearly brought out by the author in regard to angles, sacralization, and faulty development are correct. The paper is an excellent one and many former and perhaps somewhat hazy ideas are clarified.

Dr. von Lackum's conclusions follow.

CONCLUSIONS.

1. The lumbosacral joint is an unstable mechanism because (a) it is the juncture of a mobile and an immobile part; (b) the usual means of joint stabilization are at a disadvantage in consequence of a developmental structure designed for the all-four position; (c) it is the site of rotating action which is often asymmetrical; (d) it is the site of tremendous shearing strain.

2. The strain at the joint is always shearing, regardless of position.

3. The shape of the first sacral is of primary importance in reducing this strain because of its bearing on the angles which either increase or decrease it.

4. Backache may be caused by an increased angle and consequently increased strain.

5. Backache following long bed rest or acute illness may be the result of so-called normal strain which cannot be controlled by the weakened muscles.

6. The occurrence of fractures and dislocations in this region is facilitated by the rotating action in the joint.

7. Anatomic deformities in this region are active causes of disability and deformity.

8. Fusion can be done without fear of affecting the usefulness of the part.—*H. A. Pingree, M.D., Portland, Maine.*

SOLUTION OF A SERIOUS KINEPLASTIC PROBLEM. Bosch Arana and Wildermuth. *Revue d'orthopédie*, July, 1923.

This paper has to do with the problem of designing an efficient artificial arm, the finger flexion of which is to be under the control of the flexor muscles of the stump in cases of amputation only a few inches below the elbow. The flexor-pronator muscle mass on the anterior aspect of the stump is tunnelled to permit the use of a thong. The contraction of the muscle mass, in extent about 4 cm. only, pulls up on the thong, which in turn causes finger flexion. The difficulty has been that flexion of the elbow at once shortened the distance between the muscle mass and the artificial hand, with the result that with elbow flexion the finger movements due to the pull of the muscle mass disappeared. The grave problem referred to is the question of how to design an artificial arm for such a kineplastic operation, permitting artificial movements of the fingers in elbow flexion as well as in extension. Various unsuccessful expedients are described. Success has been achieved by the use of an ingenious device by which the distance between the artificial hand and the elbow joint is gradually increased as the elbow is flexed, thus maintaining exactly the distance between the hand and the muscle mass and permitting no slackening of the thong. In this way artificial finger flexion is permitted quite as strongly and with as great an amplitude of motion whether the albow be extended or flexed. The illustrations should be studied.—*J. Appleton Nutter, M.D., Montreal.*

CYSTIC DISEASES OF THE BONES: A STUDY OF FIFTEEN CASES. Ashley P. C. Ashhurst, Ralph S. Bromer, and Courtland Y. White, *Archives of Surgery*, May, 1923.

This article is essentially a report of cases of cystic bone disease. Ashhurst initiates his discussion with a statement that the disease of the tissues of the body may be classified under three headings, infections, dystrophies, and tumors. He points to the fact that inasmuch as there is a wide variation in diagnoses, on account of the experience, judgment, and attitude of the physician, there will consequently be a great difference in the classification. He expatiates upon certain facts under these three headings. A detailed report of the condition and course of the cases is given in more or less hospital parlance. These discussions are illustrated by photographs and roentgenograms. Bromer gives a description of the radiograms of the cases. White discusses here and there the pathologic findings. This article emphasizes certain facts relative to the disease under discussion but does not give any clear and clean cut conclusions. The facts which the average reader wishes to note are strewn through a considerable amount of unnecessary parlance.—*William J. Merrill, M.D., Philadelphia.*

STRUCTURE AND EVOLUTION OF THE TOPHUS OF GOUT. A. Chauffard and M. Wolf. *Presse Médicale*, Dec. 5, 1923, p. 1013.

The authors studied a number of tophi from two gouty patients. Chemically all contained uric acid and cholesterine. The tophus is a conglomeration of small irregular cavities surrounded and bound together by connective tissue. Each cavity is filled with a mass of lipoid and fat which contains needlelike urate crystals. Around the border of the central fatty mass are numerous foreign body giant cells and here and there in the connective tissue framework are islets of eosinophilic cells. There is no infiltration of leucocytes and almost no evidence of any inflammatory change. There are no areas of necrosis or degeneration. Around some of the smaller cavities are a few mononuclears.

The cholesterine is in the center and the sodium urate around the periphery of the tophus. The origin of the tophus seems to be due to the tendency of colloids (cholesterine) in suspension to absorb crystalloids (urates) in solution; then both are precipitated.—*J. Albert Key, M.D., Baltimore.*

Osteogenesis Imperfecta Affecting Two Generations. H. J. C. Gibson. *Edinburgh Med. Journ.*, June, 1923.

The writer records brachycephaly and lax sacroiliac and hip-joint ligaments as characteristic of the condition in the mother in the absence of any fracture. A sister of the mother was reported to have a similarly shaped head and a spontaneous fracture of the femur in infancy, the combination being regarded as evidence of the presence of the dyscrasia. Three children of the mother had numerous fractures, with large bitemporal diameters of the heads, regarded by Cameron as a sign of osteogenesis imperfecta.—*Charles A. Parker, M.D., Chicago.*

Ptosis of the Heart and Diaphragm. Important Points for Determination in the Chronic Patient. Joel E. Goldthwait, *Boston Medical and Surgical Journal*, October 25, 1923, p. 581.

There are easily demonstrable changes in position of the heart and in the position and movement of the diaphragm from those considered normal. These changes are important as factors in causing many disturbances in circulation or general physiology of the thoracic and abdominal viscera.

The suspensory ligament of the diaphragm is attached to the cervical fascia, and if the cervical spine is properly held, it results in the diaphragm having a dome shape, convexity upward. Thus, as with other muscles, the proper function can occur only when a normal relationship of its parts exists. To determine the situation of the diaphragm, an X-ray study should be made with the patient standing and lying. A fluoroscopic tracing of the excursions should also be made for record.

The diaphragm not only plays an important part in the function of respiration but also serves more than any other factor in forcing venous blood from abdominal and pelvic organs back to the heart.

The position of the diaphragm has been found to vary greatly and frequently from the text book position,—namely, the dome at level of eighth or ninth rib at back.

Anything lowering the position of the diaphragm will, of course, lower the position also of the heart, because the suspensory ligament of the diaphragm is the pericardium. In a functional examination of the heart, the mobility of the organ should be determined. That changes in position and mobility may disturb physiology seems evident.—*Howard Moore, M.D., Boston.*

Arthroplasty. E. W. Hey Groves. *British Journal of Surgery*, Oct., 1923, p. 234.

Arthroplasty is defined in the broad sense, as meaning the operative mobilization of any stiff joint, including those types of excision which aim at restoring mobility.

In animals a pseudarthrosis develops at the site of a fracture which is not immobilized. Such false joints develop capsular ligament, synovial cavity, containing true synovial fluid, and articular surfaces covered with fibrocartilage, showing that all the necessary elements for a joint can be formed by nature without elaborate plastic operation. But these joints are always flail joints and always develop the features of osteo-arthritis.

Experimental plastic operations show that foreign membranes, such as Cargill's and Baer's, excite excessive reaction, while autogenous membranes, free or pedicled fascia, fat, or muscle, all serve equally well for lining joints.

"Arthroplasty can never create a normal joint, and the average result is a gain in mobility at the expense of strength and precision."

Indications for arthroplasty are a complete ankylosis of a joint when function can be considerably improved by obtaining mobility. The most favorable condition for arthroplasty is bony ankylosis due to trauma or to pus infection which has long been cured.

The essentials of after treatment are continuous traction on the new articulation and early voluntary movement.

The author reports the results of the past five years' work from the British surgeons doing arthroplasties. They show good results in forty-nine percent. of elbow operations, twenty-three percent. of hips and twenty-one percent. of knees. In the elbow good results have been as frequent with excision as with arthroplasty.—*E. W. Reed, M.D., Los Angeles, Calif.*

Osteochondritis Deformans. Juvenile Schlatter's Disease and Other Allied Conditions. J. N. J. Hartley. *Edinburgh Med. Jour.*, June, 1923.

Hartley briefly reviews these interesting conditions, occurring as they do in early childhood or adolescence, and suggests with others the similarity in nature and character of epiphyseal changes occurring in all of them. Later opinions incline more to an infectious or toxic disturbance than to trauma in their causation, although evidence of bacterial infection is usually negative. Included in the list are Legg's disease of the femoral epiphysis, Osgood-Schlatter's disease of the tibial epiphysis, Köhler's disease of the navicular, painful epiphysis of the heel, fortunately not called Schinz's disease from its recorder, painful olecranon epiphysis, described by Zaaiger, and osteochondritis deformans metatarso-juvenilis described by Alberti, Valentin, and more recently by Lewin.—*Charles A. Parker, M.D., Chicago.*

Chronic Sclerosing Osteitis. Melvin S. Henderson, M.D. *Journal American Medical Association*, March 22, 1924, p. 945.

Dr. Henderson's paper has to do with a distinct type of osteitis, very chronic in its course. The roentgenogram shows a dense, fusiform, definite enlargement of the bone. The symptoms include fever, pain at night, leucocytosis, and tenderness on deep pressure. Surgery offers the only way to a cure and is sometimes futile. Resections and amputations are to be condemned. There is no suppuration, but there may be a definite sequestrum.

The paper is clear and much to the point, and is illustrated by six excellent roentgenograms.

Dr. Henderson's summary follows:

SUMMARY

Chronic proliferative sclerosing osteitis is a definite clinical entity, probably a low grade infectious process.

It is sometimes difficult to differentiate from syphilitic osteitis, sarcoma, Paget's disease, and occasionally osteitis fibrosis cystica. It is usually relieved by gutting the bone, or trephining, but is quite likely to recur, and in some instances seems to persist in spite of all measures of treatment.—*H. A. Pingree, M.D., Portland, Maine.*

LEONTIASIS OSSEA. R. Lawford Knaggs. *The British Journal of Surgery*, Oct., 1923, p. 347.

This article cannot be abstracted.

In it the author gives a detailed account of the observations in all the recorded literature regarding this condition beginning with Malpighi's description in 1700 A.D., with descriptions of all specimens of record and with many fine illustrations, both gross and microscopic. He discusses the theories of many pathologists regarding the origin, classification, and method of production of the disease.

He recognizes two great classes:

1. Cases of very chronic periostitis, spreading slowly from bone to bone, to which the title of "creeping periostitis of the bones of the face and skull" may be given.

2. Cases of diffuse osteitis of the bones of the face and skull which may be (a) general, (b) circumscribed, or (c) local. They are probably all instances of osteitis fibrosa, the last, affecting the jaws, being usually due to dental caries or irritation.

The first form probably always originates in the nasal fossae or accessory sinuses and from there extends as a chronic, slowly advancing, and productive periostitis.

The periostitic form of leontiasis ossea is in all probability the result of micro-organic infection. The osteitic form is almost certainly caused by toxins.

The findings from thirty-four cases are reported.—*E. W. Reed, M.D., Los Angeles, Calif.*

MOBILIZATION OF ANKYLOSED JOINTS. W. R. MacAusland. *Surg., Gyn., and Obstet.*, Sept. 1923, p. 255.

This article of fifty-three pages and one hundred twenty-five illustrations cannot well be abstracted in brief. Some of the main points are:

History of methods, especially arthroplasty; types of ankylosis and indications and contra-indications for arthroplasty; special features and technique for various joints, including the elbow, knee, hip, jaw, shoulder, wrist, fingers, ankle, and toes.

The elbow is discussed most fully, giving the author's well-known technique. A number of cases are reported.

The author says that with properly selected cases, in the hands of an experienced and skilled operator, movable joints and stable joints will be obtained with reasonable certainty. Arthroplasty (not excision) is always employed. The chief contra-indications mentioned are tuberculosis and extensive bone and soft tissue destruction. Other infections, including multiple arthritis, are not contra-indications if the process is not active. Pedunculated or free fascial coverings for the articular surfaces are always employed. At the elbow no effort is made to restore rotary movement of the forearm.

The descriptions of technique are not always clear or anatomically accurate, *e.g.*, the ulnar nerve is said to be found "at the inner side of the internal condyle," and in describing the operation for hallux rigidus the incision is said to be on the "lateral aspect," where the mesial aspect is evidently meant, and the toe is said to be dressed in "inversion" when adduction is meant. But these are minor inadvertencies of a valuable article.—*R. W. Billington, M.D., Nashville.*

TREATMENT OF THE PATHOLOGICALLY FLEXED KNEE. Charles A. Parker. *Jour. Am. Med. Assn.*, Oct. 6, 1923.

Four cases are reported and notes on treatment outlined. The writer advocates when correcting the position of flexion to put the knee in complete extension.—*Edward S. Hatch, M.D., New Orleans, La.*

ARTHROPLASTY: A CRITICAL SUMMARY OF THE DISCUSSION ON THIS SUBJECT AT A MEETING OF THE SIXTH CONGRESS OF THE INTERNATIONAL SOCIETY OF SURGERY, HELD IN LONDON, JULY 18, 1923. Alan H. Todd. *British Journal of Surgery*, Oct., 1923, p. 319.

The consensus of opinion regarding arthroplasty, while optimistic, is that the operation requires a high degree of skill and that it still needs much development. Attempt was made, somewhat unsuccessfully, to place a distinction between arthroplasty and excision: one faction, representing the ideas of John B. Murphy and led by MacAusland, contending that "arthroplasty, to be functional, must be stable, and excision of joints results always in flail joints." The French speakers, representing the views of Ollier, contended that as good results were often obtained by subcapsula excision as by arthroplasty.

It was generally agreed that sound bony ankylosis resulting from bygone pyemia presented the most favorable field for arthroplasty, and that ankylosis from tuberculosis is a contraindication. It was considered justifiable to operate a year or two after the acute infection, but no sooner. The condition of the soft parts, e. g., destruction of skin, muscles, vessels, or nerves, must also be taken into consideration.

The following indications were generally accepted:

1. Two stiff hips will indicate arthroplasty on one hip or possibly both.
2. Two stiff elbows present the same indication.
3. Two stiff knees indicate an arthroplasty on one side at least.
4. Combination of stiff hips and knees in one individual indicates mobilization of one or more joints.

Putti stressed due consideration of the temperamental, social and economic aspects of every case. Occupation has an important bearing—working men being usually better off with a stiff joint in good position than with a movable one of questionable stability. Unless the patient really needs a movable joint and is willing and anxious to co-operate in the after treatment, enduring the pain of early movement, the operation should not be performed. Arthroplasty is contraindicated in rheumatoid arthritis. Putti advocates active movements of the knee twelve days after the operation.

It was the opinion of the French representatives, concurred in by some of the British, that a flail joint is never the result of excision of a joint, provided the excision is intracapsular, the danger being rather a recurrence of ankylosis. Elmslie stressed the relief of pain as an indication for arthroplasty, preferring arthrodesis, however, except in multiple ankyloses not due to rheumatoid arthritis.—*E. W. Reed, M.D., Los Angeles, Calif.*